
**M990 GCR
CacheTape® Unit
Technical Manual**

cipher

Federal Communications Commission (FCC) Notice

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Cipher Data Products, Inc. provides this manual "as is," without warranty of any kind either expressed or implied. Cipher may make improvements and/or changes in the products described in this manual at any time.

All information contained in or disclosed by this document is considered proprietary by Cipher Data Products, Inc. By accepting this material the recipient agrees that this material and the information contained therein are held in confidence and in trust and will not be used, reproduced in whole or in part, nor its contents revealed to others, except to meet the purpose for which it was delivered. It is understood that no right is conveyed to reproduce or have reproduced any item herein disclosed without express permission from Cipher Data Products, Inc.

TABLE OF CONTENTS

Chapter 1. Set Up and Installation	1-1
1.1 Unpacking and Repacking Instructions.....	1-1
1.2 Rack Mounting.....	1-9
1.3 Power Connection.....	1-12
1.4 Interface Connection	1-15
1.5 Interface Description	1-21
1.6 Integration of the M990 GCR	1-22
to the system	
Chapter 2. Parts and Location	2-1
2.1 M990 GCR Tape Unit-Front View.....	2-1
2.2 M990 GCR Tape Unit-Front View.....	2-2
(Unit in Service Position)	
2.3 M990 GCR Tape Unit-Top View	2-3
2.4 M990 GCR Tape Unit-Rear View	2-4
2.5 M990 GCR Tape Unit-Bottom View	2-5
Chapter 3. Illustrated Parts Breakdown	3-1
Chapter 4. Diagnostic Tests and Troubleshooting	4-1
4.1 Diagnostic Test	4-1
4.2 Troubleshooting	4-17
4.3 Main Tests	4-22
4.4 Common Tests.....	4-31
4.5 Test Point Locations.....	4-43
Chapter 5. Preventive Maintenance and Replacement Procedures	5-1
5.1 Prentive Maintenance Schedule	5-1
5.2 Placing Unit in Operator Access Position	5-2
5.3 Placing Unit in Service Position	5-3
5.4 Restoring Unit to Operating Position.....	5-3
5.5 Front Panel	5-4
5.6 Top Cover.....	5-6
5.7 Operator Access Cover	5-7
5.8 Cover Lock Assembly	5-8
5.9 AC Power Switch	5-10
5.10 Switch LED Front Panel.....	5-11
5.11 Alphanumeric Display.....	5-12
5.12 Fuse.....	5-13
5.13 Power Supply Enclosure and PWB	5-14
5.14 Blower Motor	5-16
5.15 AC Transformer	5-17
5.16 AC Line Cord.....	5-18
5.17 Supply Reel Hub	5-18
5.18 Read/Write Head.....	5-20
5.19 Tape Scraper	5-22
5.20 Take-Up Hub	5-24

TABLE OF CONTENTS

5.21	BOT/EOT Sensor	5-26
5.22	Tachometer	5-27
5.23	Tension Arm Bumper	5-28
5.24	Tension Arm/Air Capacitor Assembly	5-29
5.25	Tape-In-Path Transmitter	5-31
5.26	Tape-In-Path Sensor	5-31
5.27	Tape Guides	5-33
5.28	Manual Hub Release Assembly	5-34
5.29	Supply Reel Tab Sensor	5-35
5.30	Take-Up Motor	5-36
5.31	Supply Motor	5-37
5.32	Hub Lock Solenoid.....	5-39
5.33	Hub Lock Pawl.....	5-40
5.34	Sensor/Servo Board.....	5-41
5.35	CPU/MMU Board.....	5-43
5.36	Data Board.....	5-45
5.37	CIF Write	5-46
5.38	Tape Tracking Procedure.....	5-47
Chapter 6. Operation.....		6-1
6.1	Operator Display Panel	6-1
6.2	Operation	6-5
6.3	Operator Maintenance	6-13
6.4	Error Conditions	6-16
6.5	Read Extended Status.....	6-18
Chapter 7. Glossary		7-1
Engineering Documentation		
Title		Drawing No.
Wiring Diagram		960956-001
Rack Mount-Interface		961167-001
Power Supply Schematic		961251-300
Sensor/Servo PWB Schematic (57V)		963490-300
Sensor/Servo PWB Pictorial (57V).....		963490-000
Sensor/Servo PWB Bill of Material (57V).....		963490-001
Sensor/Servo PWB Schematic (37V)		963491-300
Sensor/Servo PWB Pictorial (37).....		963491-000
Sensor/Servo PWB Bill of Material (37V).....		963491-001
CPU/MMU PWB Schematic		963394-300
CPU/MMU PWB Pictorial		963394-000
CPU/MMU PWB Bill of Material.....		963394-002
CIF/Write PWB Schematic.....		962357-300
CIF/Write PWB Pictorial		962357-000
CIF/Write PWB Bill of Material		962357-001
Data PWB Schematic		963674-300
Data PWB Pictorial.....		963674-000
Data PWB Bill of Material.....		963674-001

1. Set Up and Installation

This manual supplies set up, installation, and maintenance information for repairing the M990 GCR tape unit, adjusting internal assemblies, and replacing field replaceable units.

1.1 Unpacking and Repacking Instructions

1.1.1 Packaging

The GCR CacheTape Unit (GCRCTU) is shipped in two, double-wall corrugated cartons. It is taped initially in a polyethylene bag and then placed between the top and the bottom polyethylene foam inserts. Each corner of the inner carton is additionally enforced with "V" boards (4). There is also a single, double-wall corrugated pad at the top and the bottom. Inside is a foam protector between the tachometer and the take-up hub.

The slide kit assembly is located in a "U" shaped, corrugated cardboard placed in the top polyethylene foam insert. The Operation and Maintenance manuals are taped to the top of the unit. All flaps are fastened. This carton is then placed into another carton with a single double-wall corrugated pad with foam corner pieces at the bottom and top. The carton is then taped closed and banded to a skid platform for extra protection. This method of packaging minimizes the possibility of damage during shipping.

1.1.2 Unpacking

1. Place the carton upright on the floor.
2. Cut the bands securing the carton to the skid.
3. Cut the tape securing top flaps.
4. Open top flaps.
5. Remove top pad.
6. Remove inner carton and set upright on a solid support (about desk height).
7. Cut the tape securing top flaps.
8. Open top flaps.
9. Remove top pad (1). See Figure 1.
10. Remove slide kit (2) from the top foam insert (3). See Figure 1.

11. Remove the top foam insert (3). See Figure 1.
12. Remove power cord and manuals (4). See Figure 1.
13. Remove tape (5) from the bag. See Figure 1.
14. Carefully lift the unit from the carton and put on the table. See Figure 2.
15. Remove slide and door tapes (5). If tie-wraps secure the slides to the chassis, remove the tie-wraps.
16. Remove door sticker (6).
17. Open the top cover (8) and secure it with the stay arm provided (9).
18. Carefully remove the Tachometer Roller Block by pulling the tachometer away from the block, then remove the block. Gently let the tachometer arm come back to rest against the take-up hub.

CAUTION

Do Not allow the tachometer to spring back against the take-up hub as this will damage the tachometer.

19. Loosen the two spring-loaded screws (2) on both sides of the base plate. See Figure 3.
20. Close the top cover.
21. Lift up on the two lower corners of the front panel to its maximum position. The latch mechanism locks in an upright position. Install the locking pin (4) provided.

WARNING

Insert the provided locking pin (4) into the hole (3) in the tape unit support arm. Never service the tape unit in the service position unless you install the locking pin. See Figure 3.

22. Remove the two foam blocks from between the printed wiring boards and the chassis sides.
23. Return front panel to its original position and tighten the two spring loaded screws (2) on the top base plate.

CAUTION

Do not attempt to operate GCRCTU until all foam sheets have been removed. Failure to do so will cause unit to overheat and could damage equipment.

The GCRCTU is ready for inspection. Check the contents of the shipping container against the packing slip and inspect for possible damage. **Notify the carrier if damage exists.**

NOTE

Save all packaging materials and the shipping carton. Should your drive ever need to be shipped again, these will provide it with the best possible protection.

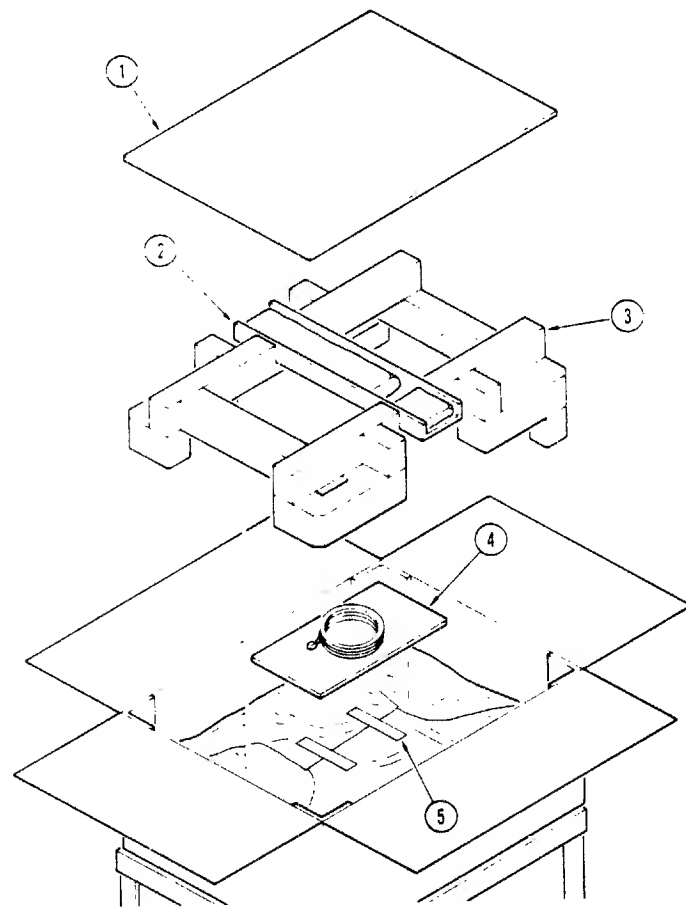


Figure 1.

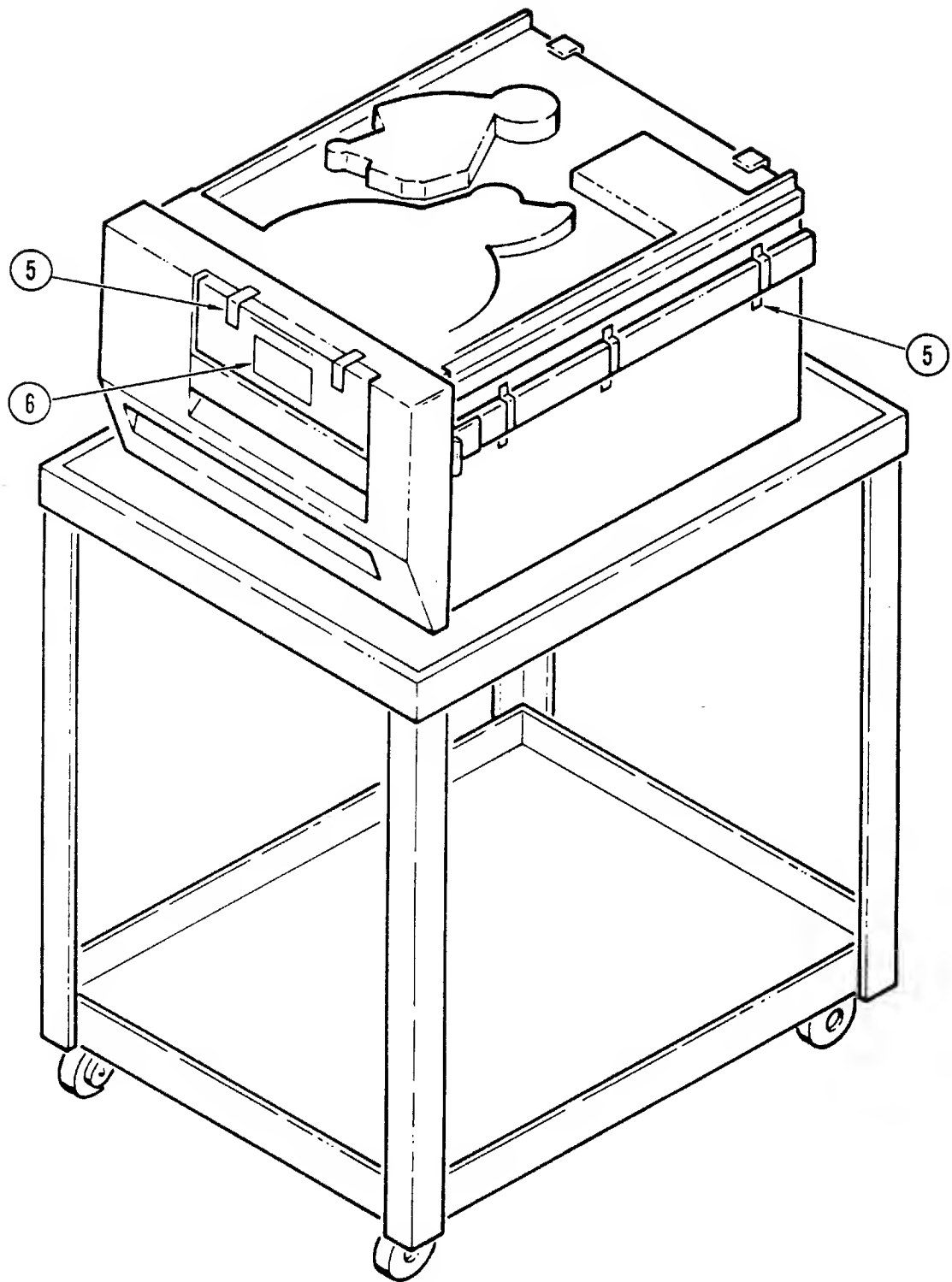


Figure 2.

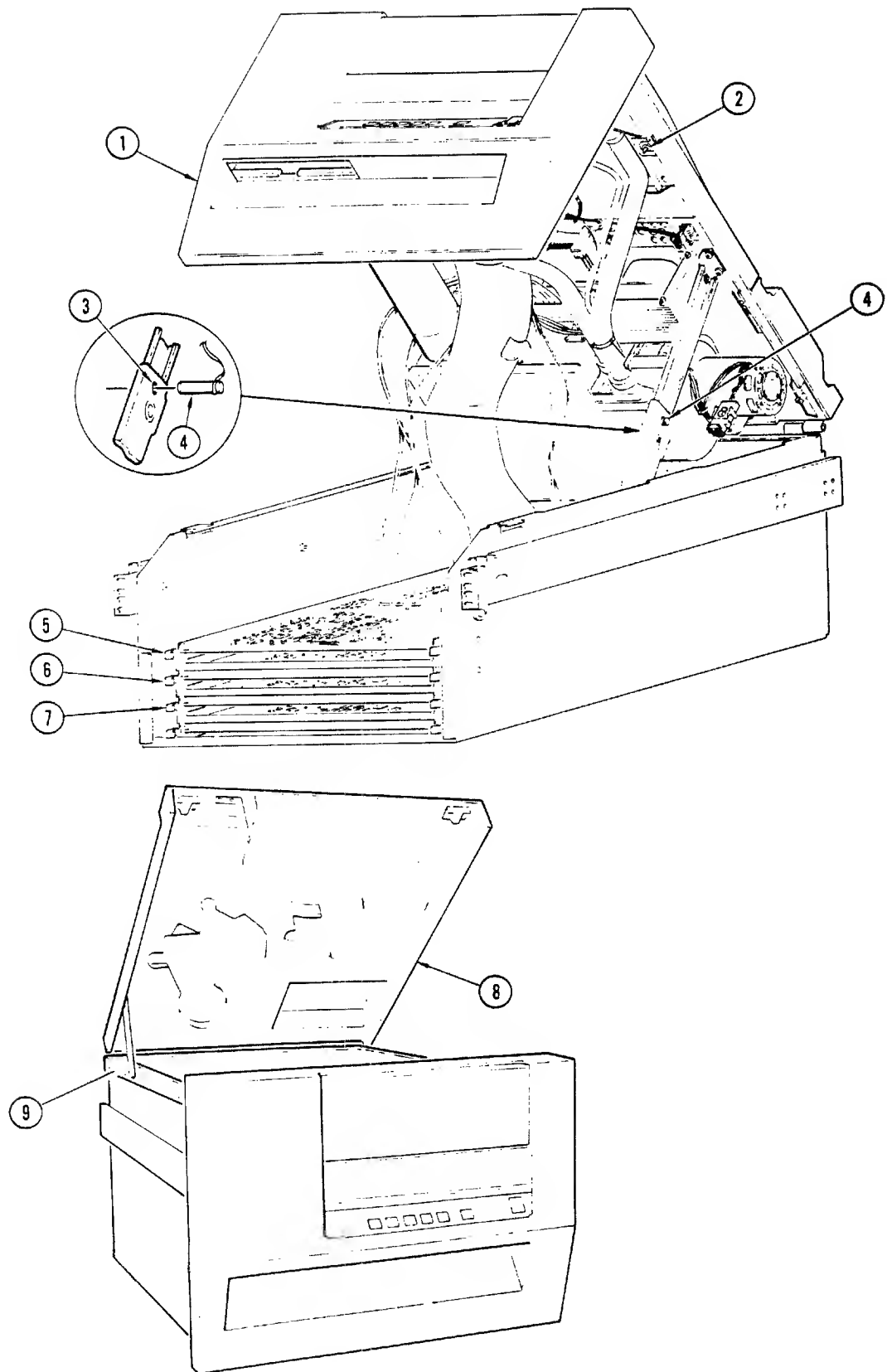


Figure 3.

1.1.3 Repacking GCRCTU

1. Using masking tape, tape the front panel door closed. Replace the front panel cover.
2. Open the top cover and install the Tach Roller Block on the take-up hub. See Figure 4. Loosen the chassis retaining screws and place the drive in the service access position. Use the support pin; see Figure 3. Insert the three thin foam pads in between the PWBs; insert the two foam blocks between the PWBs and the chassis, one on each side of the PWBs. Remove the safety pin, close the drive, and tighten the retaining screws.
3. Put the GCR into the plastic shipping bag that it originally came in. Tape bag closed.
4. Ensure that a deck pad (cardboard sheet) is in the bottom of the inner shipping carton.
5. Place the bottom frame into the bottom of the carton. Insert the V-boards into each corner of the carton. See Figure 5.
6. Carefully lift and lower GCRCTU into the shipping carton. (Be sure unit is in correct orientation with bottom frame).
7. Place power cord into a plastic bag and seal it up with tape. Set this bag on top of drive and tape in place with masking tape.
8. Place the top frame (correctly oriented) on top of the GCRCTU, and place the top deck-pad on top of the foam bars. See Figure 6.
9. Fold the short flaps into the box and the long flaps onto the short flaps. If a staple gun is available, install five staples equally spaced across the top of the box near the seam.
10. Seal the box by using reinforced tape. One piece centered across the long seam, and two pieces centered across the edge seams.
11. Insert one of the spacers that came with the outer shipping carton into this carton with the foam blocks up.
12. Place the inner shipping carton inside the outer shipping carton.
13. Fit the other spacer into the outer carton with the foam blocks down.
14. Fold the short flaps into the carton and the long flaps onto the short flaps. Install six staples equally spaced along the seam.
15. Seal the carton with reinforced tape, one piece centered along the seam, and two pieces centered along the two edge seams.

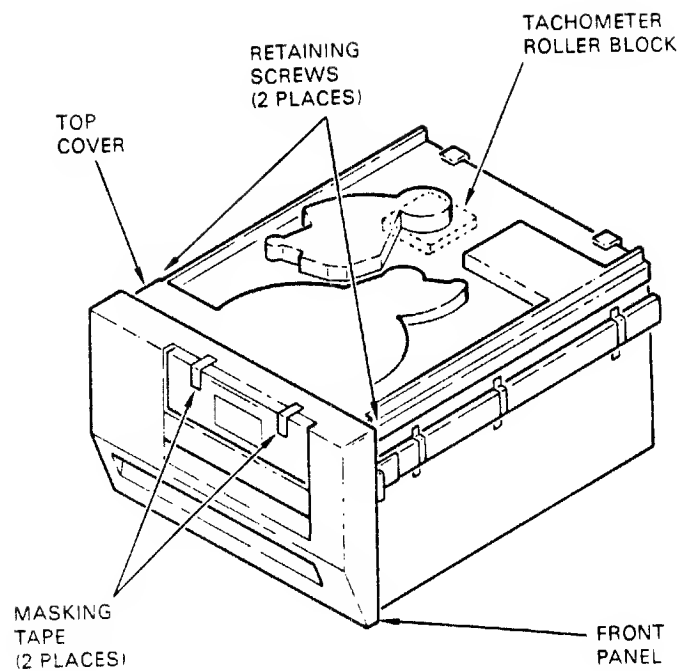


Figure 4.

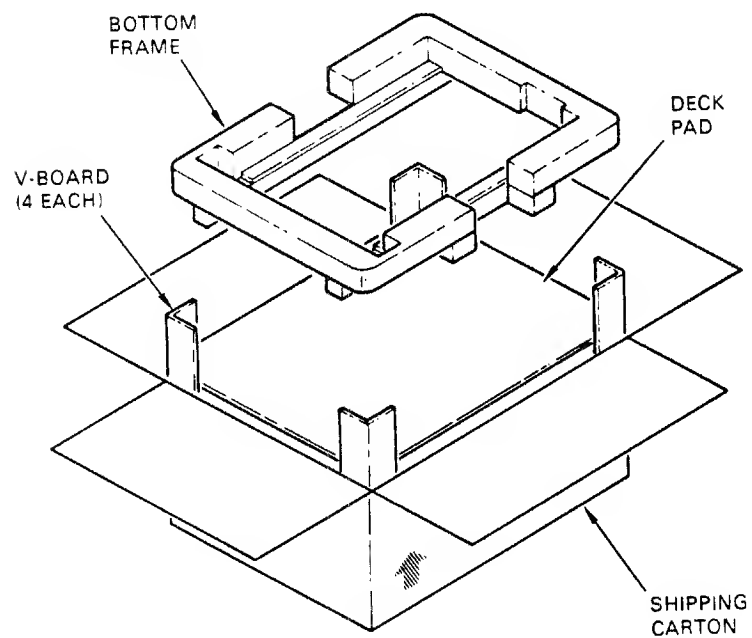


Figure 5.

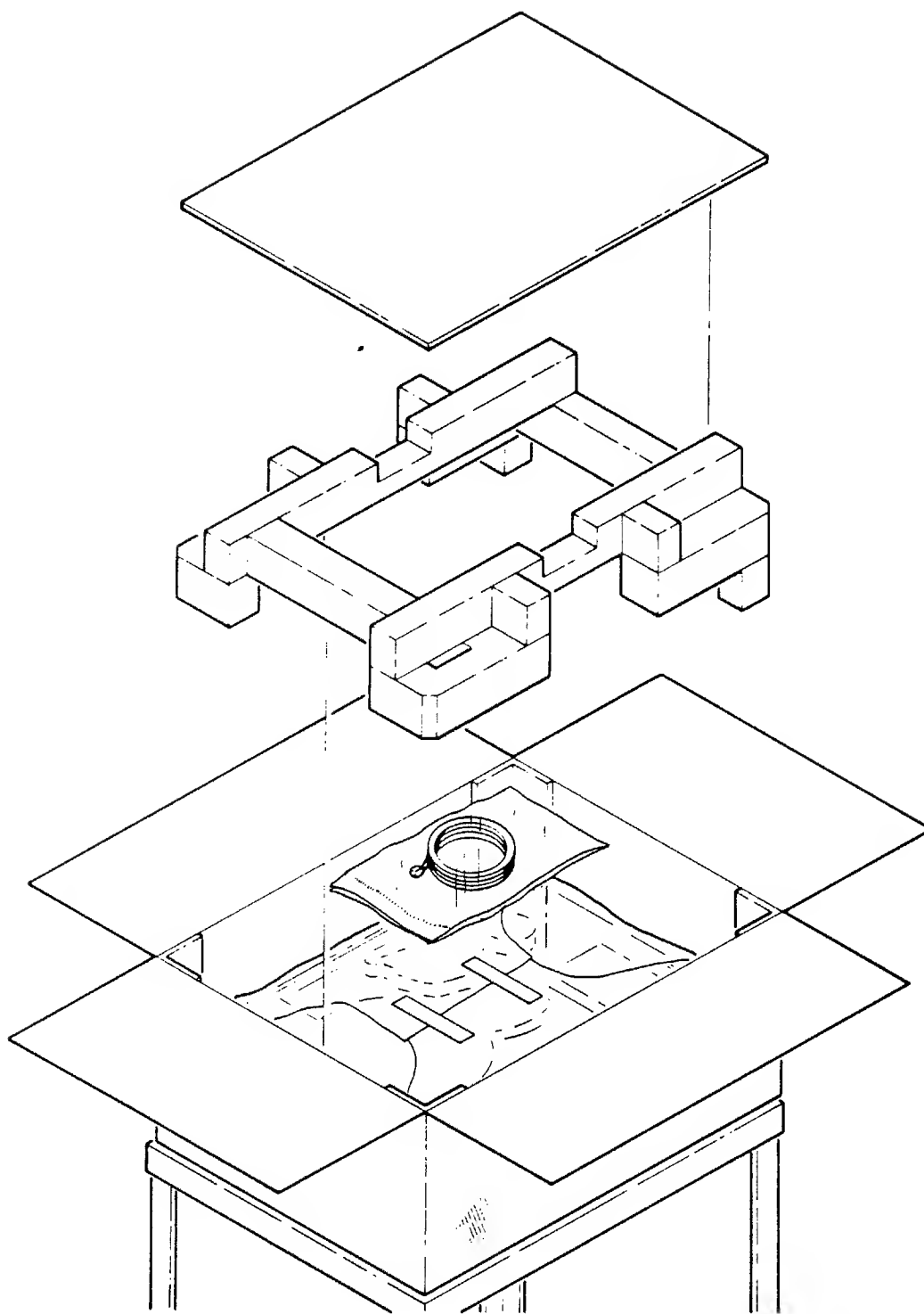


Figure 6.

1.2 Rack Mounting

The GCRCTU is designed to be mounted in a standard, 19-inch-wide, EIA equipment rack using the slides and mounting hardware provided with each unit. The tape drive must be mounted with no front panel obstructions. Refer to Figure 7 to mount the drive as follows:

1. Locate the front and rear holes to be used on the equipment rack (1, Figure 7). If they are threaded, drill them out to 0.281 inches.
2. Place the drive in service access position. Refer to paragraph 5.2.
3. Starting with either side, remove the stationary section of the slide (2) from the drive by pulling the stationary section to the rear of the drive and pushing down on the locking lever. Then pull the slide rearward another 1/2 inch, push inward on the spring lock, and remove the stationary section.
4. Determine, for the depth of the rack, the appropriate holes to use in the mounting bracket and secure it loosely to the stationary section using two screws (4) and a nut plate (5).
5. Mount the front flange of the stationary section (2) to front rail by placing flange behind rack rail holes.
6. Install two screws (6), first through front of rail, then through the stationary section flange, and secure them loosely with a nut plate (7).
7. Mount the mounting bracket to the rear by placing the flange in front of the rack rail holes.
8. Install two screws (8), first through back of rack, then through mounting bracket flange, and secure them loosely with a nut plate (9).
9. Check the alignment and correct as necessary. Tighten front, rear, and mounting bracket attachment screws.
10. Repeat steps 3 through 9 for the other slide.

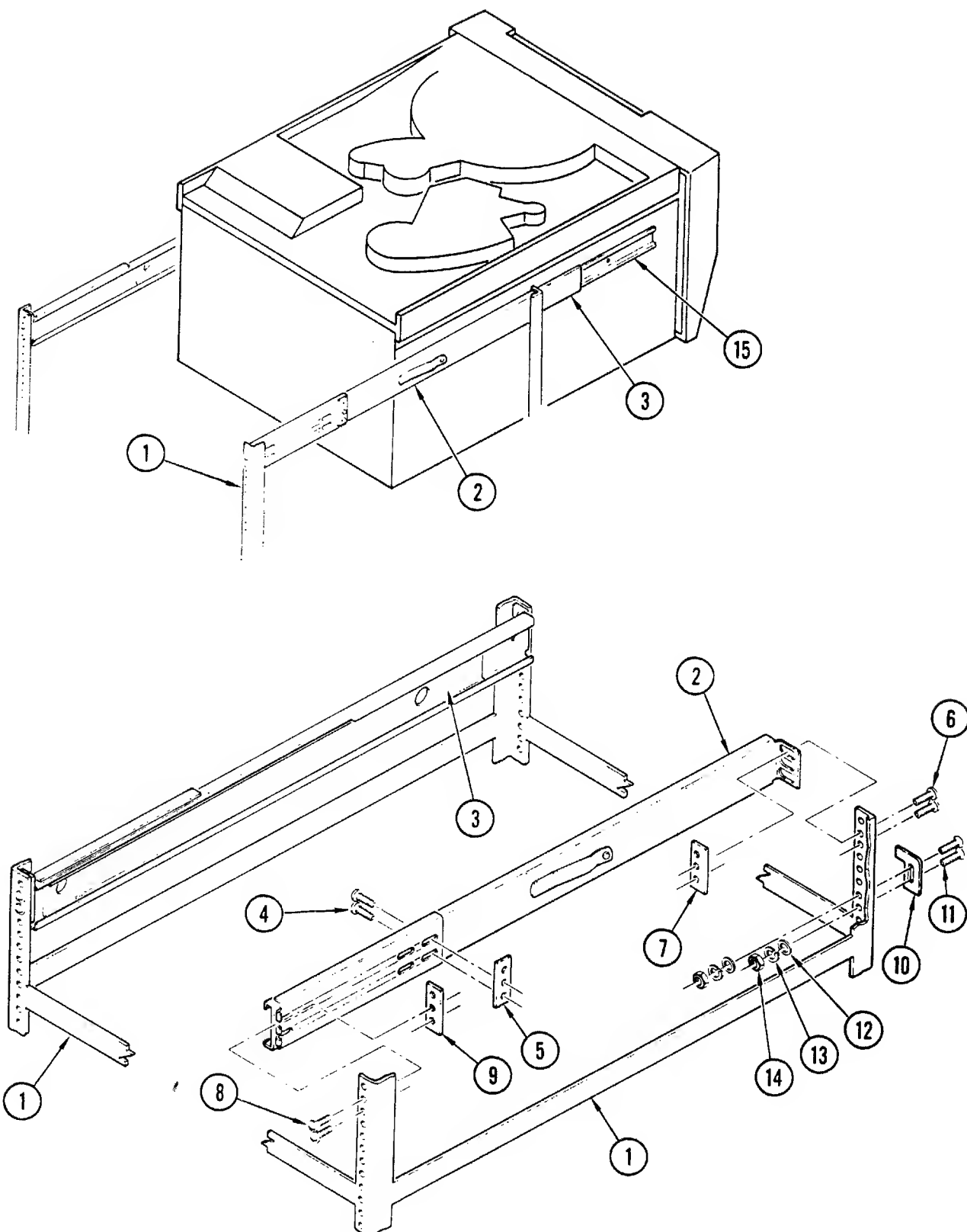


Figure 7. Rack Mounting

11. Install the bottom edge of the rack latch bracket (10) on the left rail 2.13 inches below the center-line of the slide using two screws (11), flat washers (12), split-lock washers (13), and nuts (14).
12. Carefully slide the drive into the rack-mounted slide sections while checking for binding or interference. Release the locks and, before closing fully, check that the rack latch will engage securely.
13. Adjust the rack latch bracket (10) or slides as required. To release, squeeze the rack latch plate inside the air duct opening at the lower left of the front panel.

1.2.1 Removing Slides

CAUTION

Use two people to remove the drive from the equipment rack.

1. Slide the drive outward fully from the equipment rack.
2. Push down on the locking lever of the slides, then pull the drive outward another 1/2 inch.
3. Push inward on the secondary spring lock (round button on side of slide near lever), then pull the drive out of the equipment rack and set it on a table.
4. There are two slide members still attached to the drive; both must be removed. Push inward on the leaf spring to allow the sliding member to be moved.
5. Align the access hole near the rear of the sliding member over the rear screw securing the stationary member. Remove the rear screw, then move the sliding member as necessary to remove the other two screws are secured by nuts accessible inside the chassis.

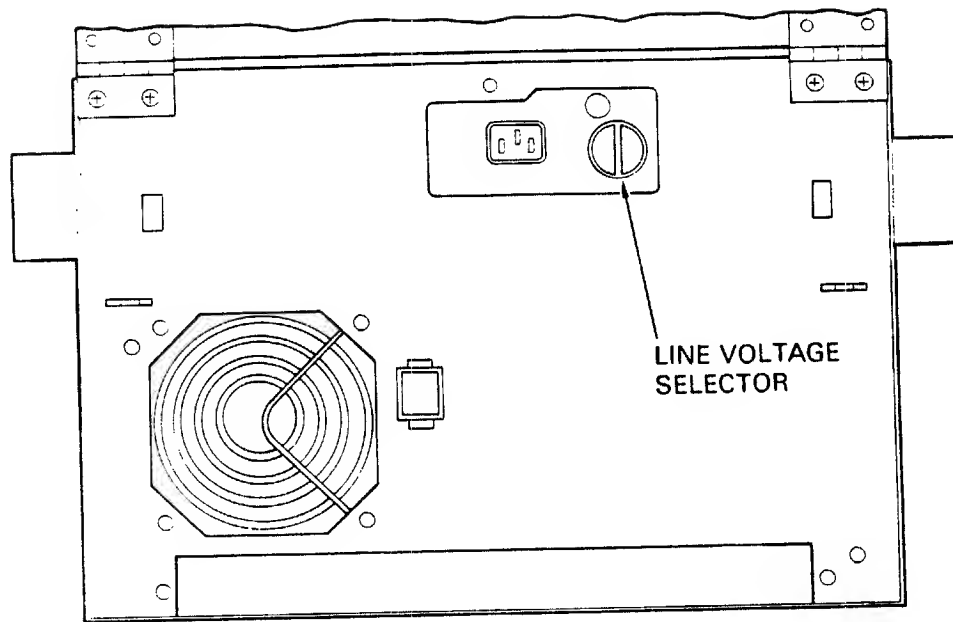
1.3 Power Connection

The a-c input voltage to the M990 is determined by a multi-position select switch located at the rear of the tape unit. The following voltages and frequencies may be selected:

NOMINAL VOLTAGE (Vac)	FREQUENCY (Hz)	AVAILABLE VOLTAGE (Vac)	OPERATING VOLTAGE LIMITS (Vac)	AC SWITCH SELECTION (Hz)
100	49-61	85-110	85-110	100,50/60
104	49-61	88-110	88-114	100,50/60
110	49-61	96.5-119	96.5-120	120,50/60
120	49-61	104-127	102-132	120,50/60
200	49-61	190-220	170-220	200,50/60
208	49-61	180-220	170-220	200,50/60
220	49-61	193-238	187-242	220,50/60
230	49-51	202-249	187-249	220,50/60
240	49-51	210-259	204-264	240,50/60
240	49-61	208-254	204-264	240,50/60

CAUTION:

To prevent damage to the M990 and ensure proper operation, be sure the outlet voltage is correct before applying power to the tape unit. Also, be sure the correct fuse is installed for the selected voltage. Section 5.12 explains how to change the fuse.



A power cord is supplied only for the voltage range indicated on the manufacturer's label.

1.3.1 Plug Connector - Power cord preparation - 3 conductor, 1-phase, 16 Amp max.

This unit may or may not have an electrically acceptable plug attached to the power cord. Select a plug from the chart on the following page that corresponds to the country in which the machine is being installed. If more than one plug is acceptable for use in your country, you must select a plug with an electrical rating equal to or greater than the machine rating.

This plug should comply with IEC Publication 83, and be marked with a safety agency mark acceptable to the country of installation.

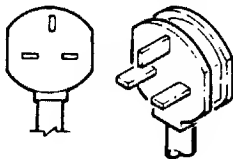
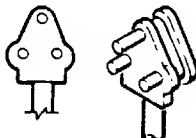

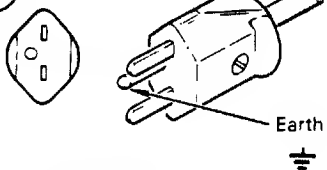



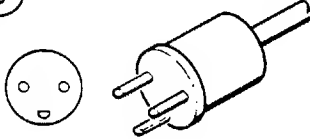
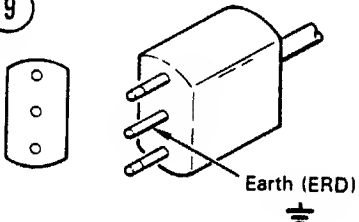
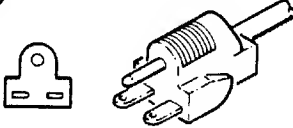
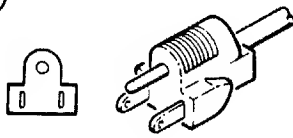
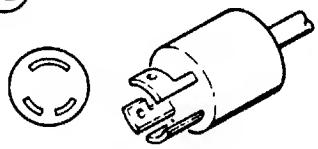
The Power Cord wires must be prepared by stripping the outside jacket and wire insulation to make with the respective plug. Strain relief clamps on the plug must secure the outside jacket of the power/cable when finished.

1.3.2 Power Cord Connections to Plug

1. Connect the blue wire to the Neutral terminal or the plug.
2. Connect the brown wire to the line (Hot) terminal on the plug.
3. Connect the green/yellow wire to the Earth terminal on the plug.

PLUG OUTLINE:
DELINEACIONES DE CLAVIJAS (EL):

STECKER SKIZZE:
BOUCHOM DECOURANT:

<p>①</p>  <p>13 Amp. 250 Volt BS 1363</p>	<p>②</p>  <p>15 Amp. 250 Volt BS1 546</p>	<p>③</p>  <p>6/16 Amp. 250 Volt (Earth Pin may be round) S.I. 32</p>
<p>④</p>  <p>10 Amp. 250 Volt (Voltage Pins may be round) SNV 24509</p>	<p>⑤</p>  <p>16 Amp. 250 Volt CEE7</p>	<p>⑥</p>  <p>10 Amp. 250 Volt Approved as C112-1964</p>
<p>⑦</p>  <p>16 Amp. 250 Volt CEE7</p>	<p>⑧</p>  <p>6/10 Amp. 250 Volt Approved AFSNIT 107</p>	<p>⑨</p>  <p>16 Amp. 250 Volt</p>
<p>⑩</p>  <p>15 Amp. 250 Volt IEC 83 UL 498</p>	<p>⑪</p>  <p>15 Amp. 125 Volt IEC 83 UL 498</p>	<p>⑫</p>  <p>15 Amp. 125 Volt</p>

① United Kingdom
Ireland
Malaysia
Singapore
Argentina

② South Africa

③ Israel

④ Switzerland

⑤ Germany
Austria
Bulgaria
Finland
Iceland
Indonesia
Iran
Netherlands
Norway
Poland
Portugal
Romania
Spain
Sweden
Turkey
Bolivia

⑥ Australia
New Zealand
Uruguay

⑦ France
Belgium
Greece
Hungary
Yugoslavia

⑧ Denmark

⑨ Chile
Italy

⑩ United States
Canada

⑪ Bahamas
Barbados
Bermuda
Brazil
Canada
Colombia
Costa Rica
Dominican Rep.
Ecuador
Guatemala
Honduras
Jamaica

⑫ Mexico
Antilles
Nicaragua
Panama
Paraguay
Paru
Philippines
Taiwan
Trinidad
Venezuela
United States

⑫ Japan

1.4 Interface Connection

Note: If the M990 is to be connected with the SCSI Interface, please refer to the SCSI Addendum, part number 799893-002, at this time.

Interconnection to the M990 and system equipment should be made with a twisted-pair shielded cable with approximately 110 ohms of characteristic impedance. To ensure reliable performance, the cables should have:

1. A maximum length of 30 feet to include service loop. The length of cable from the host to the first tape unit must not exceed 15 feet.
2. The cable length between units connected in the daisy chain harness should not exceed 10 feet.
3. 22 or 24 AWG conductors with a 0.01 inch minimum insulation thickness and not less than one twist-per-inch for twisted-pair cables.

It is important that the ground wires of twisted-pair be grounded at each end of the cable.

Note: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions included in this manual, may cause interference to radio communications. Verification of compliance with Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference, is the responsibility of the installer. Interface connectors provided on the GCR are shown in Fig. 8. Tables 1 and 2 list the pin locations for interface inputs and outputs.

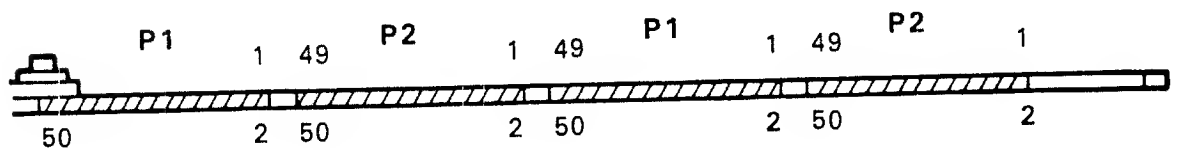


Figure 8. Interface Connectors

The M990 may be configured to allow of up to eight transports with a single controller. Use cables similar to those described above for interconnection of transports. Refer to Figures 9 and 10.

To configure the M990 to operate on a multiple transport system, proceed as follows:

1. Place M990 in service access position. (See Section 5.2.)
2. Remove terminator resistor pack U1B and U3C (Figure 10) from the CIF/Write PWB of each transport except the last one in the chain.
3. Install interconnection cables as shown in Figure 10.

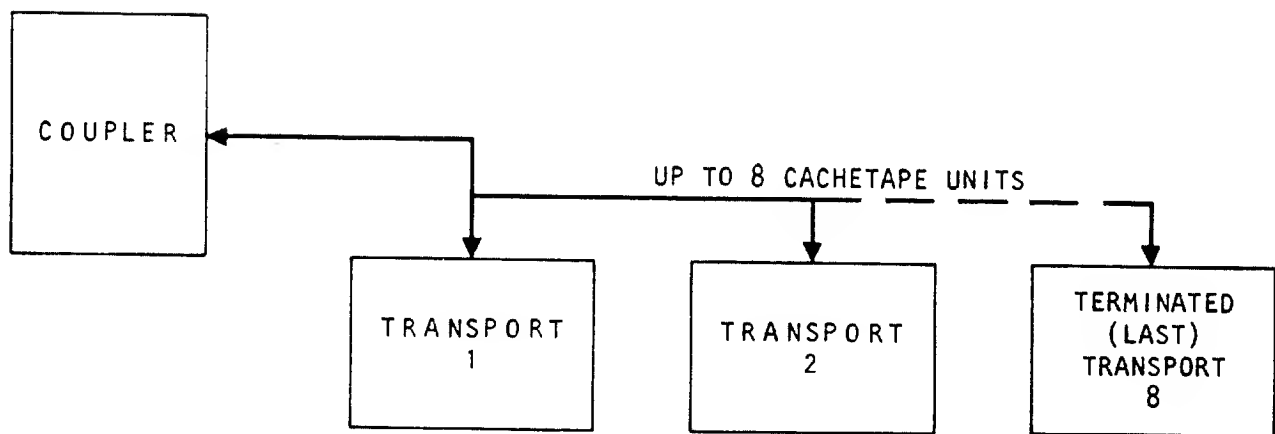


Figure 9. Daisy Chain Block Diagram

FROM
COUPLER
OR
PREVIOUS
TRANSPORT

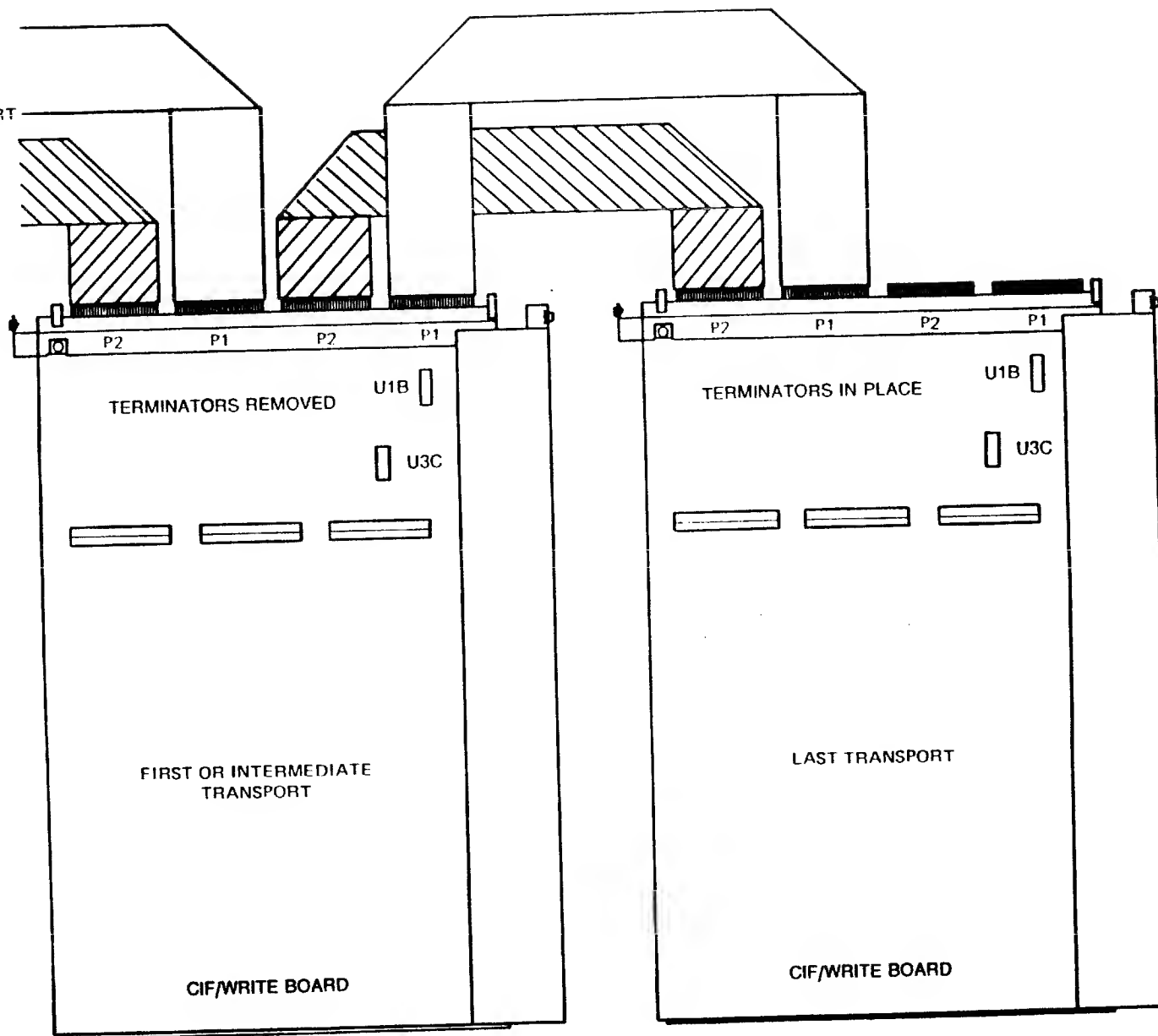


Figure 10. Daisy Chain Configuration

Plug No.	Live Pin	Ground Pin	Signal Description	Signal Name
P1	4	3	Last Word	ILWD
P1	6	5	Write Data 4	IW4
P1	8	7	Initiate Command	IGO
P1	10	9	Write Data 0	IWO
P1	12	11	Write Data 1	IWI
P1	16	15	Load On-line	ILOL
P1	18	17	Reverse	IREV
P1	20	19	Rewind	IREW
P1	22	21	Write Data Parity	IWP
P1	24	23	Write Data 7	IW7
P1	26	25	Write Data 3	IW3
P1	28	27	Write Data 6	IW6
P1	30	29	Write Data 2	IW2
P1	32	31	Write Data 5	IW5
P1	34	33	Write	IWRT
P1	36	35	Not Used*	---
P1	38	37	Edit	IEDIT
P1	40	39	Erase	IERASE
P1	42	41	Write File Mark	IWFM
P1	44	43	Not Used*	---
P1	46	45	Transport Address 0	ITADO
P2	18	17	Formatter Enable	IFEN
P2	24	23	Rewind/Unload	IRWU
P2	46	45	Transport Address 1	ITADI
P2	48	47	Formatter Address	IFAD
P2	50	49	Not Used*	---

* These are properly terminated for compatibility with other products.

Table 1. Interface Signals, Controller to Transport

Plug No.	Live Pin	Ground Pin	Signal Description	Signal Name
P1	2	1	Formatter Busy	IFBY
P1	48	47	Read Data 2	IR2
P1	50	49	Read Data 3	IR3
P2	1	--	Read Data Parity	IRP
P2	2	--	Read Data 0	IR0
P2	3	--	Read Data 1	IR1
P2	4	--	Load Point	ILDLP
P2	6	5	Read Data 4	IR4
P2	8	7	Read Data 7	IR7
P2	10	9	Read Data 6	IR6
P2	12	11	Hard Error	IHER
P2	14	13	File Mark	IFMK
P2	16	15	Identification	IDENT
P2	20	19	Read Data 5	IR5
P2	22	21	End of Tape	IEOT
P2	28	27	Ready	IRDY
P2	30	29	Rewinding	IRWD
P2	32	31	File Protect	IFPT
P2	34	33	Read Strobe	IRSTR
P2	36	35	Write Strobe	IWSTR
P2	38	37	Data Busy	IDBY
P2	42	41	Corrected Error	ICER
P2	44	43	On-Line	IONL

Table 2. Interface Signals, Transport to Controller

TAPE DRIVE COMMAND LINES.

Decoding these five lines produces the commands listed below.

	IREV	IWRT	IWFM	IEDIT	IERASE
Read Forward	0	0	0	0	0
Read Reverse	1	0	0	0	0
Read Reverse Edit	1	0	0	1	0
Write Forward	0	1	0	0	0
Write Edit	0	1	0	1	0
Write File Mark	0	1	1	0	0
Erase Variable Length	0	1	0	0	1
Erase Fixed Length	0	1	1	0	1
Security Erase	0	1	1	1	1
Space Record Forward	0	0	0	0	1
Space Record Reverse	1	0	0	0	1
Space File Search Forward (Ignore Data)	0	0	1	0	1
Space File Search Reverse (Ignore Data)	1	0	1	0	1
Write Sync/Status Hold	0	0	0	1	1
Select 3200 CPI	1	0	1	1	1
Select 1600 CPI	0	0	1	1	1
Select 6250 CPI	1	1	0	0	0
Read Extended Status	0	0	0	1	0
Current Status	0	0	0	0	0
Configuration Status	1	0	0	0	0
Error History Status	0	0	0	1	0
Machine Status	1	0	0	1	0
Error History Status	1	0	0	1	1
Diagnostic Write	1	1	1	1	1
Write NovRam	0	1	0	1	0
Store NovRam	0	1	0	0	0
Diagnostic Write	1	1	1	1	1

1.5 Interface Description

Commands, status, and data are exchanged between the host controller and the M990 GCR tape unit via the interface section. The interface signals are all active low.

Interface Input Signals

The following signals are received by the M990 from the host controller.

- IGO Initiate Command. Used to latch the command specified on the command lines into the selected ready GCR tape unit.
- IFEN Formatter Enable. Enables the GCR tape unit. With GCR tape unit on-line and IDBY true, pulse will reset a command "runaway" condition.
- IREW Rewind. Interface input signal. With GCR tape unit ready, on-line, and not at BOT, causes tape to rewind in reverse direction.
- IREWU Rewind/Unload. With GCR tape unit on-line, cause selected unit to go off-line, rewind to BOT marker, and then unload the tape.
- IREV Reverse.
- IWRT Write.
- IWFM Write File Mark.
- IEDIT Edit.
- IERASE Erase.
- ILWD Last Word. Used during a write operation to indicate that the character to be strobed into the formatter is the last character of the record.
- IW0-IW7 Write Data. Input lines that carry write data from the host controller to the GCR tape unit.
- IWAD- (MSB) Address lines used to select a daisy-chained GCR tape unit.
- ITAD0, ITAD1-LSB

TAPE DRIVE ADDRESS			Logical Address
IFAD	ITAD0	ITAD1	
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

1.6 Integration Of The GCR To The System

To optimize performance of the GCR in the system, certain operating parameters for block size, ramp delay, simulated speed, parity, and various options need to be adjusted using diagnostic test 142. Refer to section 4.1.3.

This test is designed to be used by a knowledgeable service technician only when the GCR configuration needs to be redefined from the default values listed below.

1. Option inactive -	
2. Host Supplied Parity -	No
3. Echo Read Strobes - On Write	Yes
4. EOT Mode -	Normal
5. Forward Hitch Enabled -	Yes
6. Echo 3200 bpi ID Burst -	No
7. Option inactive	
8. Abort Active Writes on Overwrites	No
9. Interface Transfer - Rate (kHz)	158.2
10. Default Density on Power Up	6250 BPI
11. Maximum Block - Size (k bytes)	9
12. I/F Ramp Delay -	3 MS
13. Write Sync Options -	ALL WRTS
14. Read Error Retries -	3
15. Write Error Retries -	15
16. Read Error Correction on -	Yes
17. Unit Address	0
18. Lock Out 3200 bpi - Writes	No
19. Remote Density - Select Enabled	Yes
20. Report Corrected Errors - Enable	Yes
21. Allow Single Track Write Errors -	No
22. 6250 Write Current - (read as XX.XX ma)	XXXX
23. 1600 Write Current -	XXXX
24. 3200 Write Current -	XXXX

25. 6250 RAW Threshold - (read as 0.XXX mv)	XXX
26. 1600 RAW Threshold -	XXX
27. 3200 RAW Threshold -	XXX
28. 3200/6250 BPI Select as 6250 BPI -	No
29. Display "feet to EOT" -	No
30. Write Error Override	No
31. Remote Load/On-Line	No

Note: Items 22 thru 27 are not alterable by tests 142/242. If the operating parameters have not been previously established, the optimum operating configuration can be determined as follows:

1. Select a data transfer rate that you know to be compatible with the system, or try the default value of 158.2 kHz. Refer to the section 4.1.3 of this manual (test 142). The data transfer rate can be calculated using the following equation:

$$\text{Tape Speed (ips)} * \text{Density (bpi)} = \text{Data Transfer Rate (kHz)}$$

2. Run an actual tape program or functional tape diagnostic to establish basic compatibility; e.g., measure time to backup 10 megabytes as a reference.

Calculate the throughput using the following formulas:

$$\frac{\text{Total Number of Bytes Written}}{\text{Total Time Required to Complete Write (seconds)}} = \text{bps}$$

$$\text{bps}/1000 = \text{kHz}$$

Note: Parametric diagnostics are designed for troubleshooting a particular tape transport and are not indicative of system performance. The best tests of GCR compatibility are live programs that use the tape sub-system. Functional diagnostics that measure tape system performance are another legitimate tool.

3. Select the next higher GCR burst transfer rate using test 142.
4. Repeat steps 2 and 3 until the data rate of the GCR exceeds the data rate capability of the system, as evidenced by data late flags in the host system or a substantial increase in repositioning activity in the GCR unit (caused by write retries due to incomplete data transfers).
5. Select the next lowest GCR burst transfer rate using test 142.
6. Refer to the section 4.1.3 of this manual (test 142) and modify the other variable parameters as required to complete the configuration.

1.6.1 Parameter Functions

A number of operating parameters are available to select standard and special options and make the drive performance compatible with the system. A brief description of each selectable operating parameter function follows:

Host Supplied Parity - compares the host supplied parity with the internally generated parity of the byte at the interface, and flags IHER if they do not match.

Echo Read Strobe on Writes - echoes a read strobe on write operations for systems that require an echo to know what data is being written. However, the read data lines do not transfer data during a write operation.

EOT Mode - causes the last record to be written at, or before, the EOT marker. This function supports systems that do not accept records written beyond the EOT marker. This option should be use only where necessary, because performance degradation near EOT will occur.

FWD Hitch Enabled - causes the drive to jog the tape forward, prior to any reverse operation in order to overcome static friction.

Echo 3200-BPI ID Burst - echoes, or does not echo, a 3200-BPI ID burst, depending on the requirements of the host. This function does not depend on a 3200-BPI ID burst being present on the tape.

Abort Active Writes on Overwrites - with this option enabled, a 'write-backspace-write' operation will physically execute both writes. This becomes significant, if the operation is an erase followed by a reverse operation and then a write (directory.) In this case, it is the intent of the software to have the tape erased prior to laying down the directory over that portion of tape. This option would need to be ON for this to happen. Normal operation has this option disabled, allowing command overwrite in cache memory.

Interface Transfer Rate - sets the burst rate at which data is transferred between GCR CacheTape and the host. Transfer rates from 70.3 to 632.8 kbs.

Default Density at Power Up - specifies the density to be displayed when the drive is powered up.

Maximum Block Size - sets the maximum acceptable size for a block of data. The acceptable sizes are 9K, 16K, 32K, and 64K. The actual available size of Cache depends on the specified block size, as available Cache is based on the full size of Cache, less the specified maximum block size, plus the actual size of one more block of data. (The actual size of the data blocks being sent are often less than the specified maximum size.) The selected maximum block size specifies the record size limit Cache will accept before pulsing IHER to initiate a host system retry, and expanding the specified block size to the next larger size.

Interface Ramp Delay - selects a 0 to 15 millisecond delay to be added to the standard time gap between the receipt of IGO and when IDBY is set. This delay is the command response time which, in a start/stop drive, would be the ramp time.

Auto Write Sync on Double File Marks - enables an automatic write sync, when two successive File Mark commands are received. When disabled, it prevents time outs and throughput degradation on systems sensitive to the length of time necessary to complete writing two consecutive file marks.

Read/Write Error Retries - sets the maximum number of read/write retries GCR CacheTape will perform on one record block.

Read Error Correction ON - enables, or disables, GCR software error correction.

Unit - specifies the unit number at power up.

Lock Out 3200-BPI Writes - prevents selection of the 3200-BPI density. However, the drive can still read a 3200-BPI tape, because of the normal "default to the density found" criteria in the read operation.

Remote Density Select Enabled - allows the integrator to disable the density selection sent through the interface. With this function, the operator can override a remote selection of a density that may not be available on GCR CacheTape.

Report Correct Errors Enabled - normal (yes) setting causes all read error corrections to be reported to the host at the time for data transmission by the ICER Line. Disabled (no) disables corrected error reporting.

Allow Single Track Write Errors - limits automatic write retries in the GCR mode to blocks having more than one channel in error. Use of this option should be limited to operations where error-free data is less important than sustained data throughput.

3200/6250 BPI Select as 6250 BPI - selects the 6250 BPI density through the interface, whether the drive command is for 6250 BPI or 3200 BPI. This option should be enabled when the system uses the same bit map to select the 6250 BPI density as the drive uses to select the 3200 BPI density. In this case, the 3200 BPI must be selected from the front panel.

Display Feet to EOT - displays the number of feet available before End-of-Tape when the drive is On Line. This information takes the place of the word "Active" on the alpha display.

Write Error Override - performs the number of Write Error Retries specified in Option 15 (0, 3, 7, 11, or 15). If the write retry count in Option 15 is exceeded, a hard error (IHER) occurs and the drive continues to the next block to be written. This feature is for real-time data operations that do not require retries, or where continuous writing is

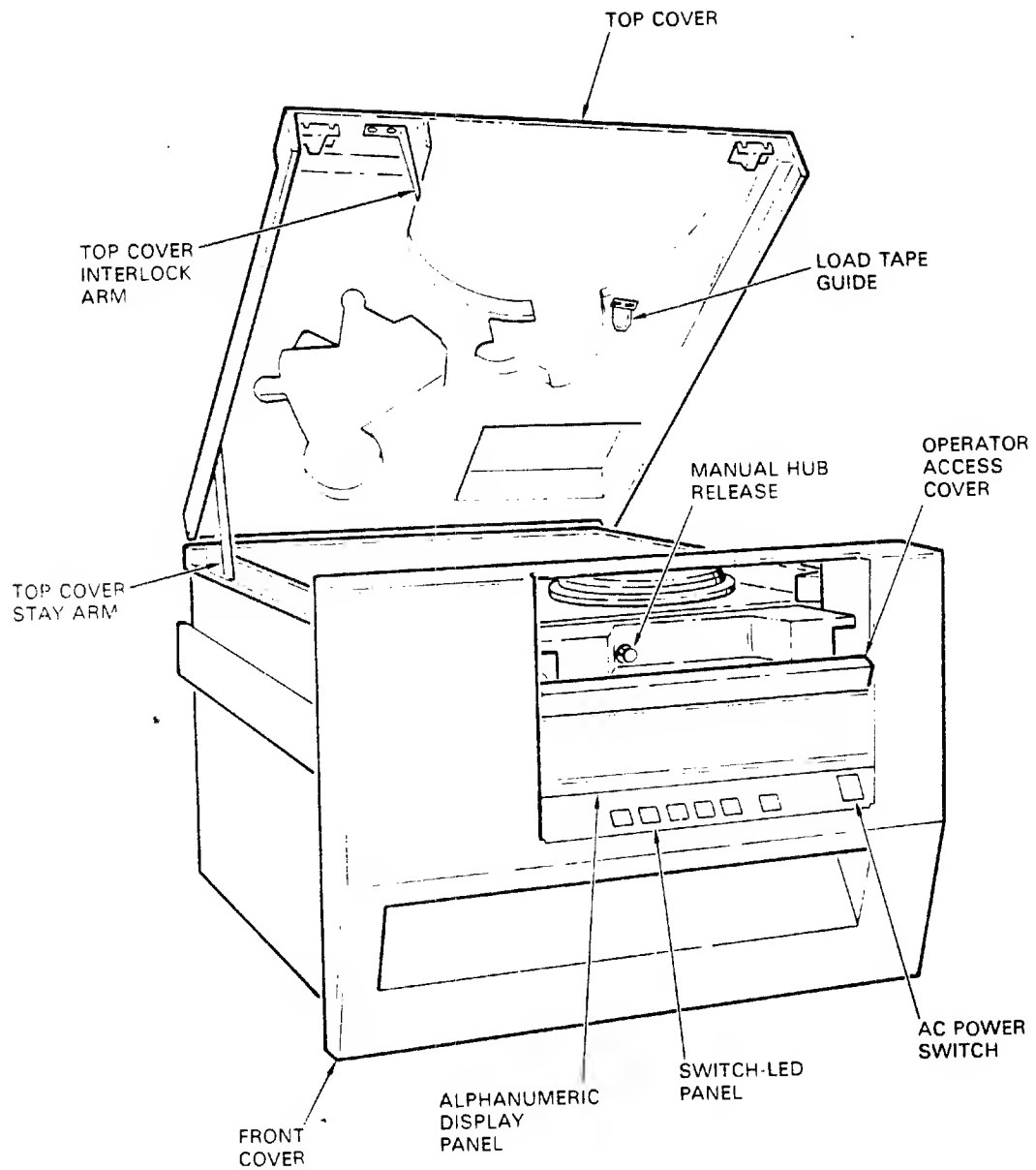
required after hard errors. "NO RETRY" is displayed instead of "ACTIVE".

Load/Online - allows a remote load and an On Line command after a tape drive in an unattended location experiences a power failure. When power is restored, the host can assert the ILOL signal (J1-16, for a minimum of one microsecond). The drive then retensions the tape, rewinds to BOT, and goes on-line.

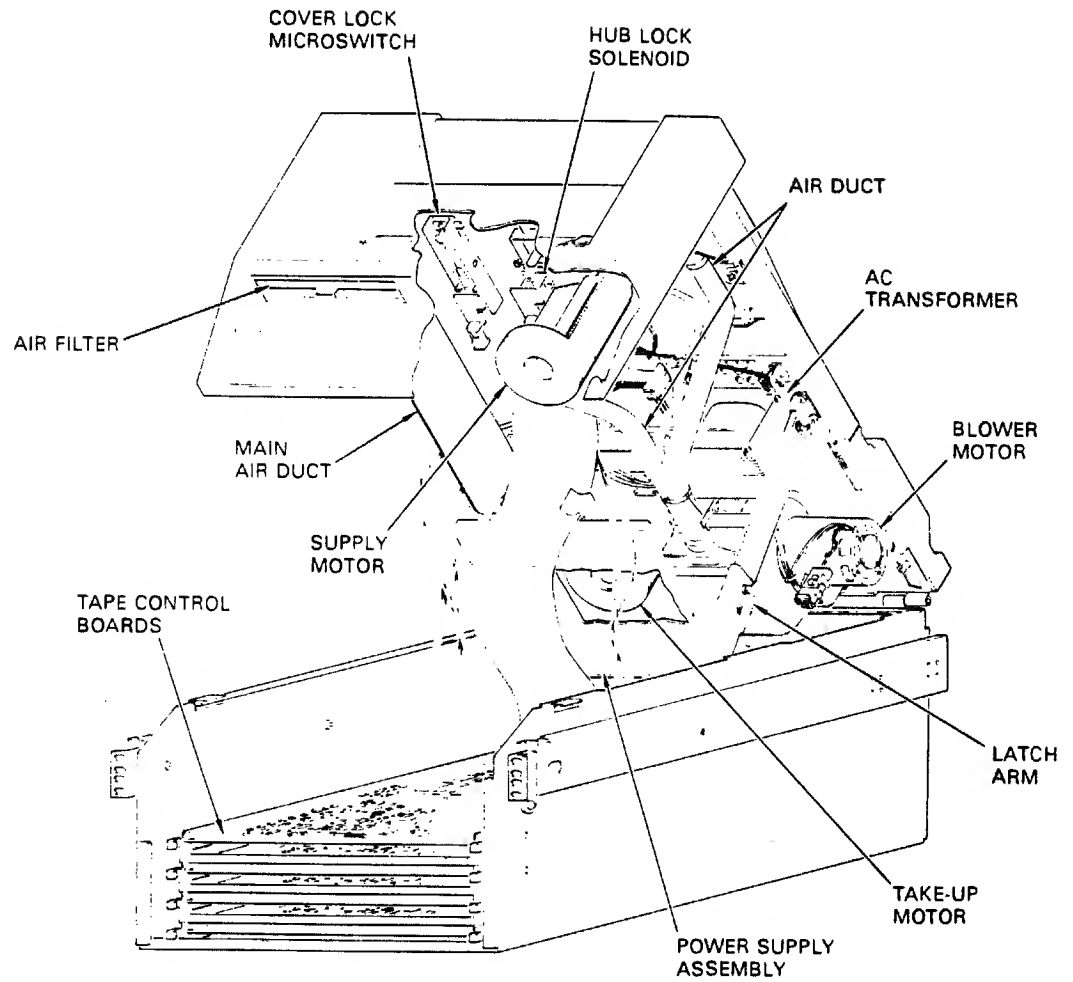
This option is implemented by jumpering from U6D pin 10 to U13F pin 21 on the CIF/WRITE PWB. The jumper connects the ILOL line to a CIO input command port.

Chapter 2. Parts and Location

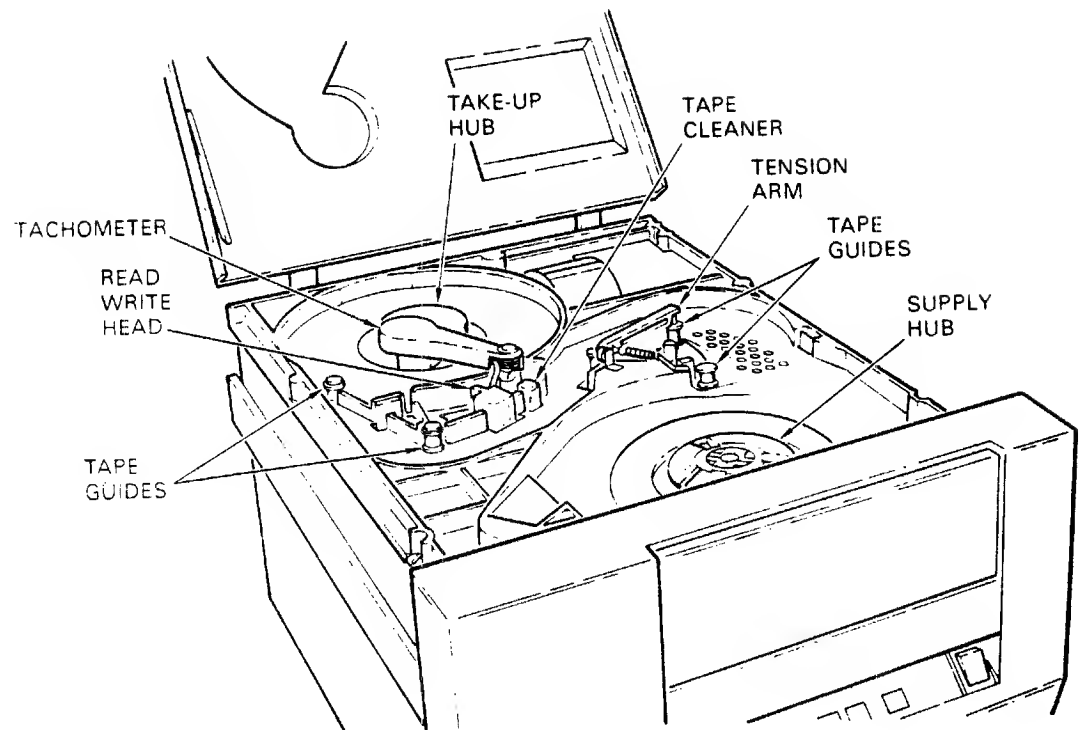
2.1 M990 GCR Tape Unit - Front view



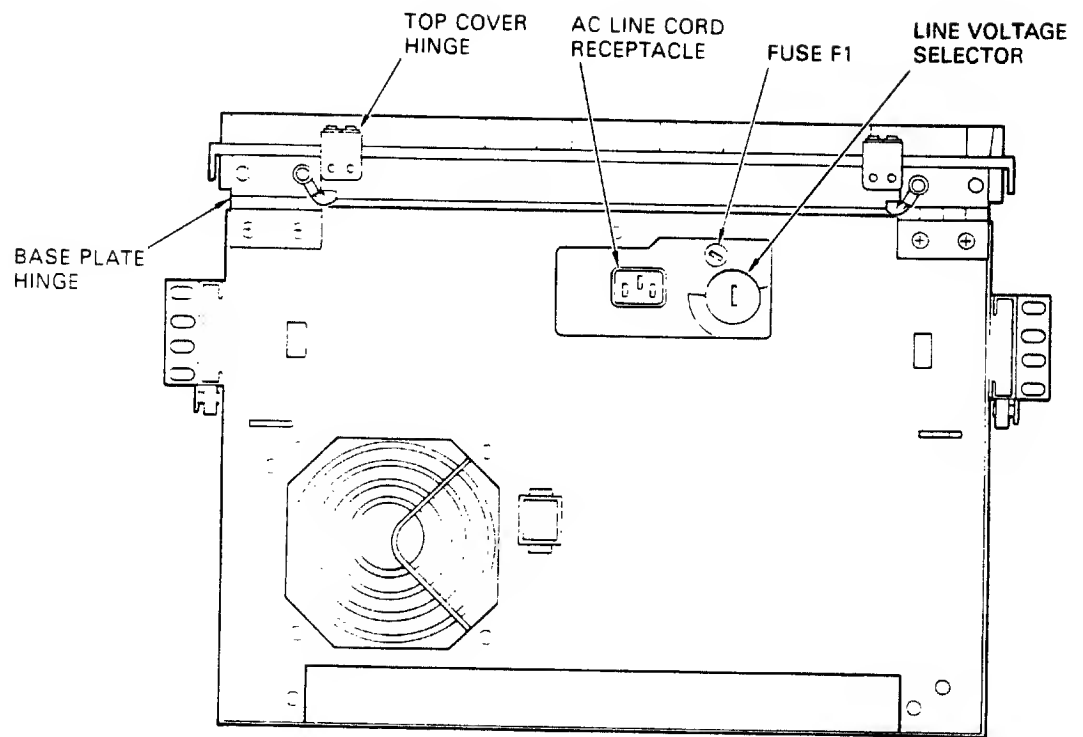
2.2 M990 GCR Tape Unit - Front View
(Unit in Service Position)



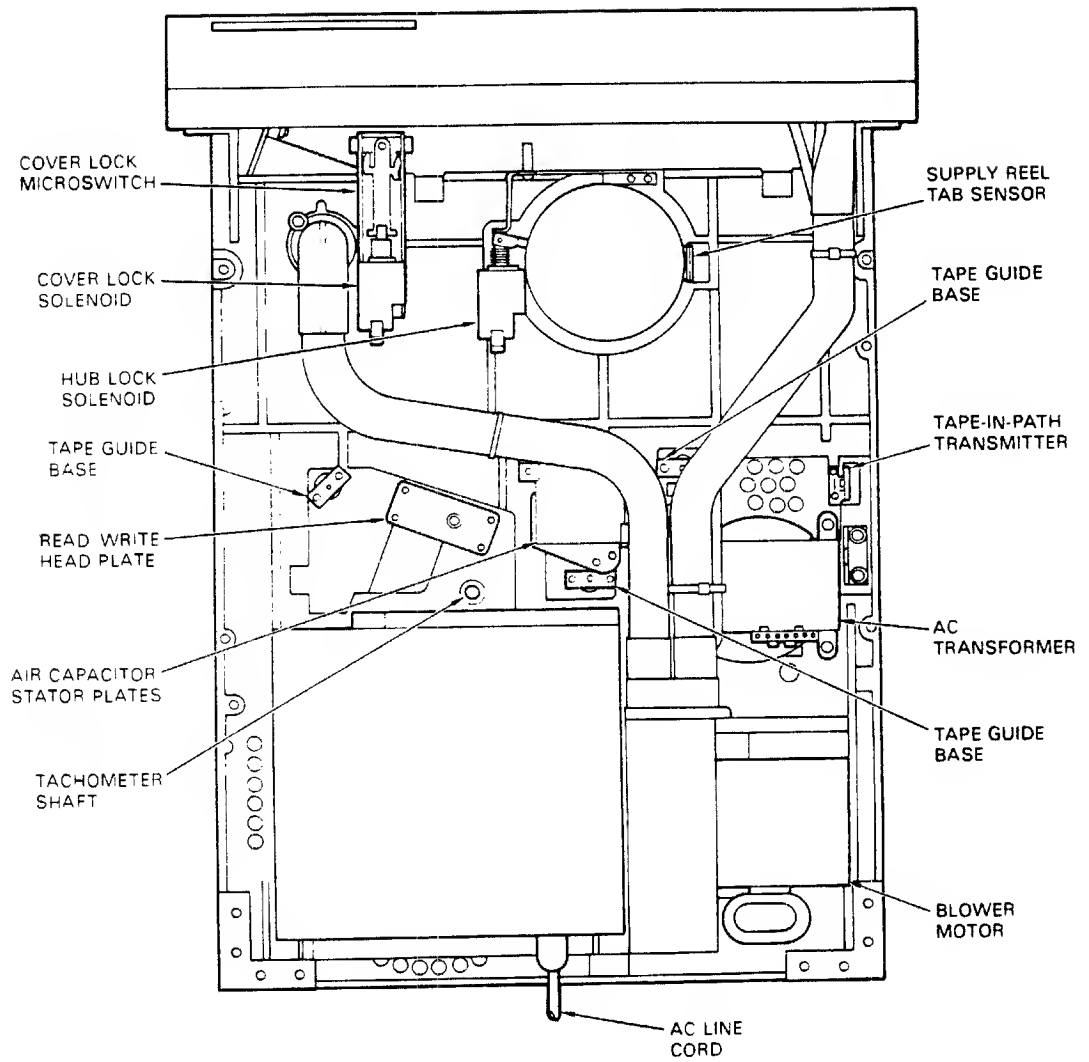
2.3 M990 GCR Tape Unit - Top View



2.4 M990 GCR Tape Unit - Rear View



2.5 M990 GCR Tape Unit - Bottom View



Chapter 3. Illustrated Parts Breakdown

The illustrated parts breakdown divides the Model M990 Magnetic Tape Streamer Unit into assemblies, subassemblies, and component parts.

Figure 3-1 is an overall view of the magnetic tape transport for use in identifying major assemblies. Figures 3-2 through 3-7 represent both an exploded view of these major assemblies and their relationships to the overall assembly.

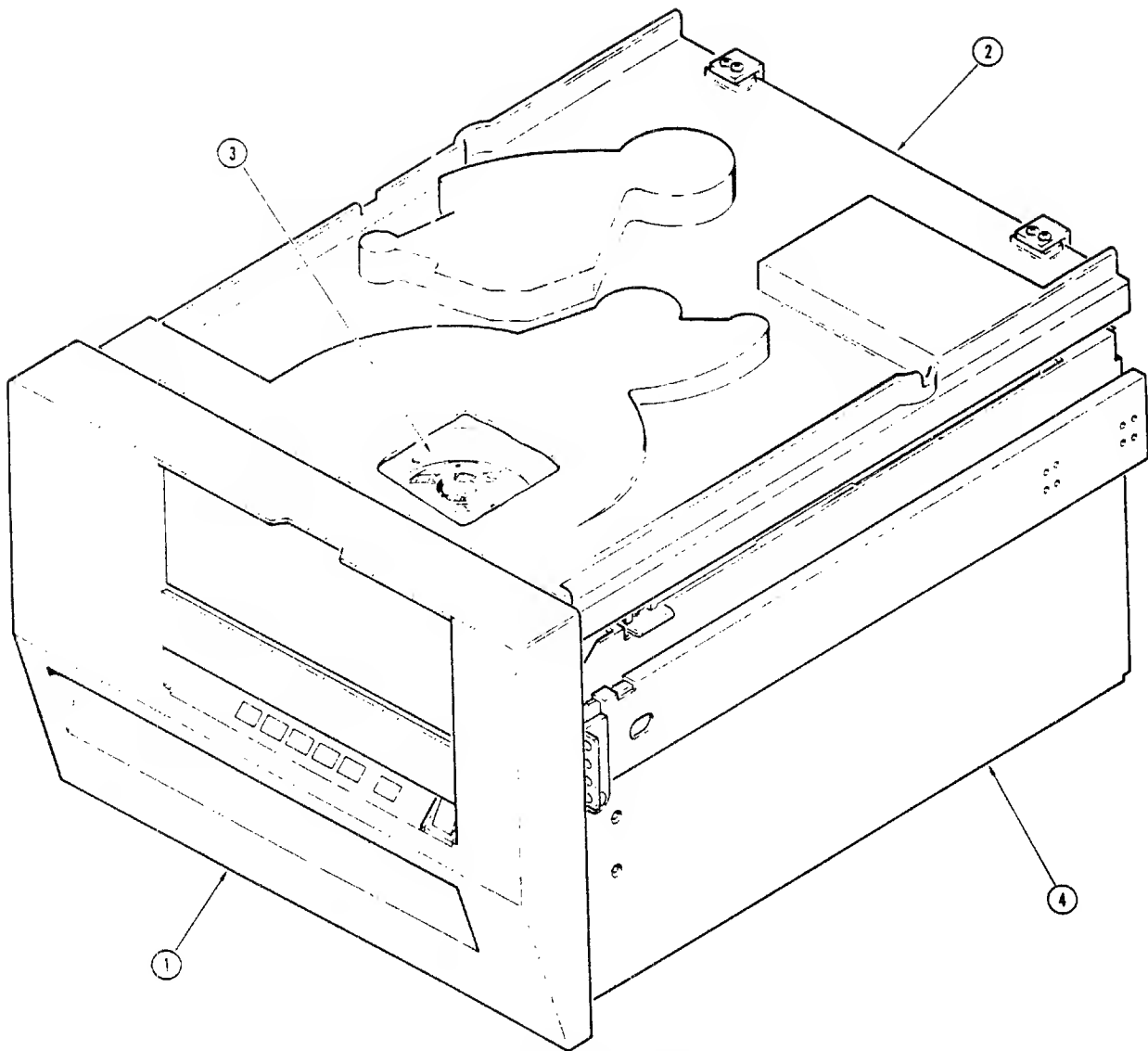


Figure 3-1. Model M990 Magnetic Tape Streamer
(Unit - Assembled View)

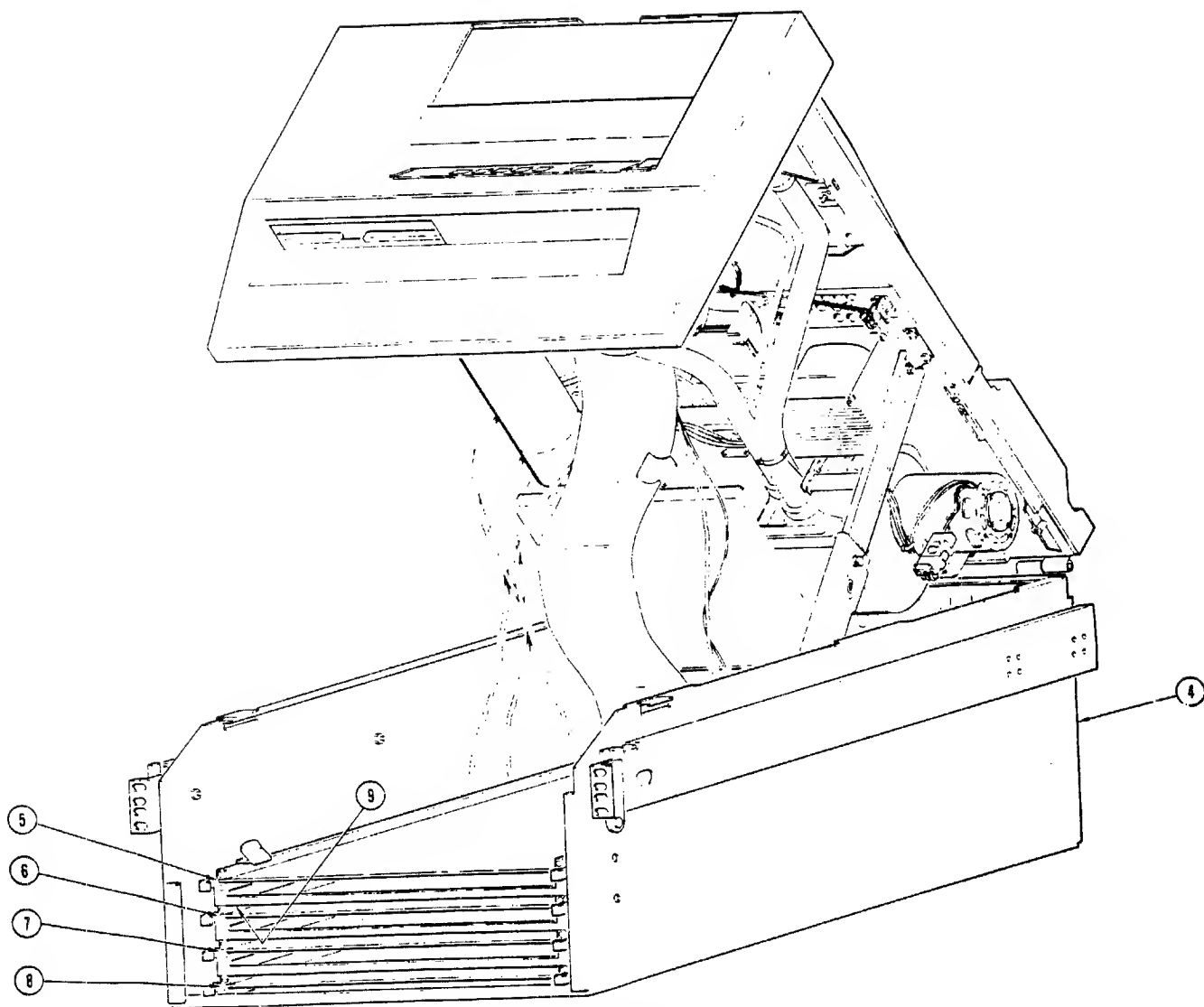


Figure 3-1. Model M990 Magnetic Tape Streamer Unit (Assembled View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
3-1	960954-007 963121-001	MAGNETIC TAPE STREAMER, Model M990 Model M990 TUV (+37V)		
-1	964145-001	FRONT PANEL ASSEMBLY (See Figure 3-3)	1	
-2	960057-001	TOP COVER ASSEMBLY	1	
-3	960942-004	BASIC DRIVE ASSEMBLY (See Figure 3-4)	1	
-4	960948-001	CHASSIS ASSEMBLY (See Figure 3-5)	1	
-5	963490-001	PRINTED WIRING BOARD ASSEMBLY, Sensor/Servo	1	
	963491-001	TUV (+37V) Sensor/Servo PWB		
-6	963394-001	PRINTED WIRING BOARD ASSEMBLY, CPU/MMU	1	
-7	963674-001	PRINTED WIRING BOARD ASSEMBLY, DATA	1	
-8	962357-001	PRINTED WIRING BOARD ASSEMBLY, CIF/Write	1	
-9	964692-001	SHIELD, PWB	1	

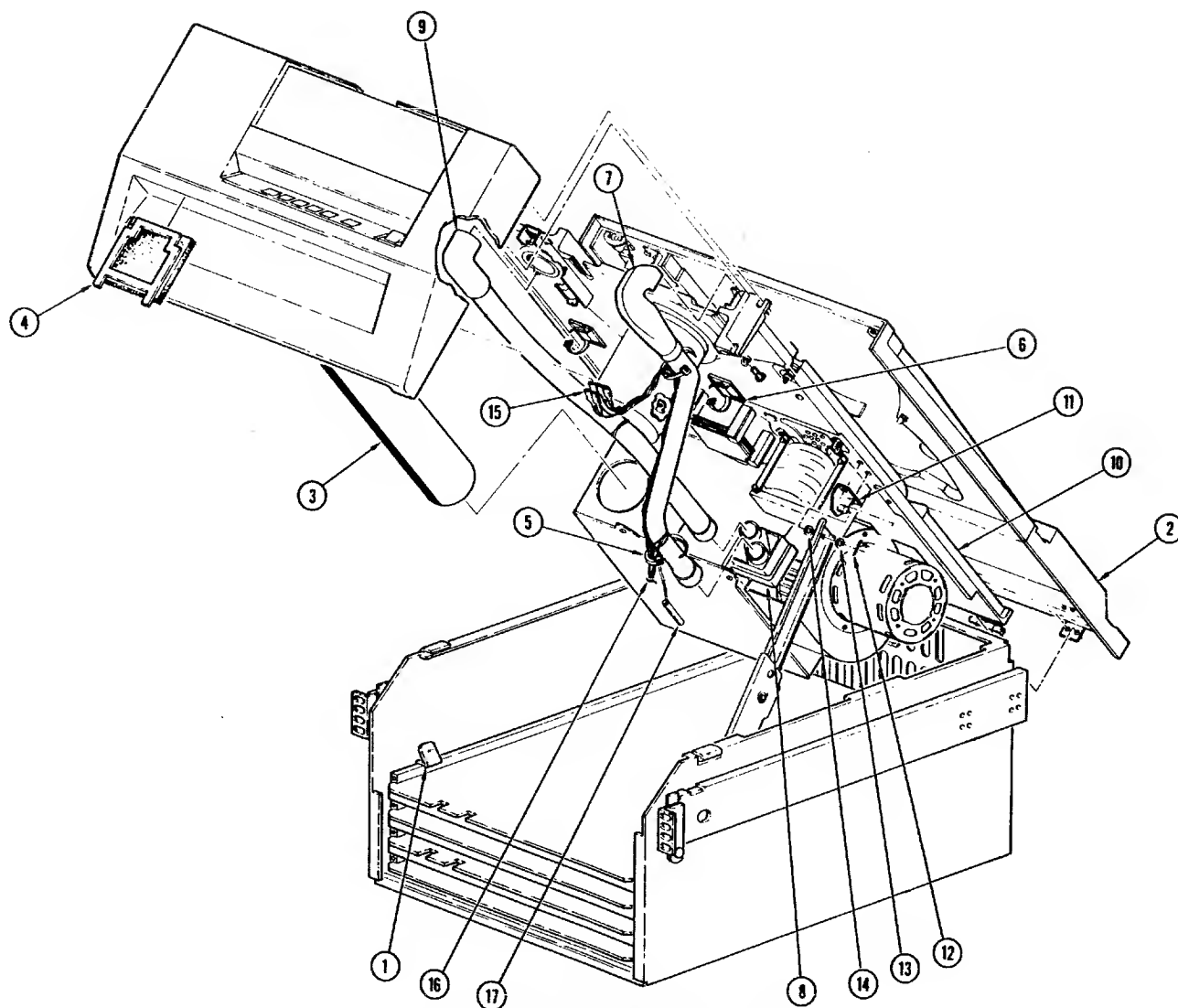


Figure 3-2. Model M990 Magnetic Tape Streamer Unit (Exploded View)

Figure 3-2
Sheet 1 of 1

FIGURE & INDEX NO	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
3-2	960954-007	MAGNETIC TAPE TRANSPORT,	REF	
-1	963787-001	. HOLD DOWN, card cage	2	
-2	960057-001	. TOP COVER ASSEMBLY	1	
-3	760101-795	. AIR DUCT (Tube)	1	
-4	961514-001	. FILTER, Air	1	
-5	210229-516	. TY-RAP, 8 in	2	
-6	970457-001	. CABLE CLAMP, adhesive backed	3	
-7	160107-478	. DUCT, Air, front panel	1	
-8	760101-609	. NOZZLE, Blower	1	
-9	760106-554	. DUCT, Air, top plate	1	
-10	960942-004	. BASIC DRIVE ASSEMBLY	1	
		(See Figure 3-4 for breakdown)		
-11	160105-418	. BRACKET, Assembly, top plate support	1	
-12	205042-509	. PIN, Cotter, 1/16 x 1/2 in. lg	1	
-13	207104-021	. WASHER, Flat, No. 10	1	
-14	961084-001	. SPACER	1	
-15	961881-001	. HARNESS ASSEMBLY, Power supply	1	
	961832-001	. HARNESS ASSEMBLY, Main	1	
-16	970134-001	. LANYARD, Elastic	1	
-17	760105-519	. PIN, Safety	1	

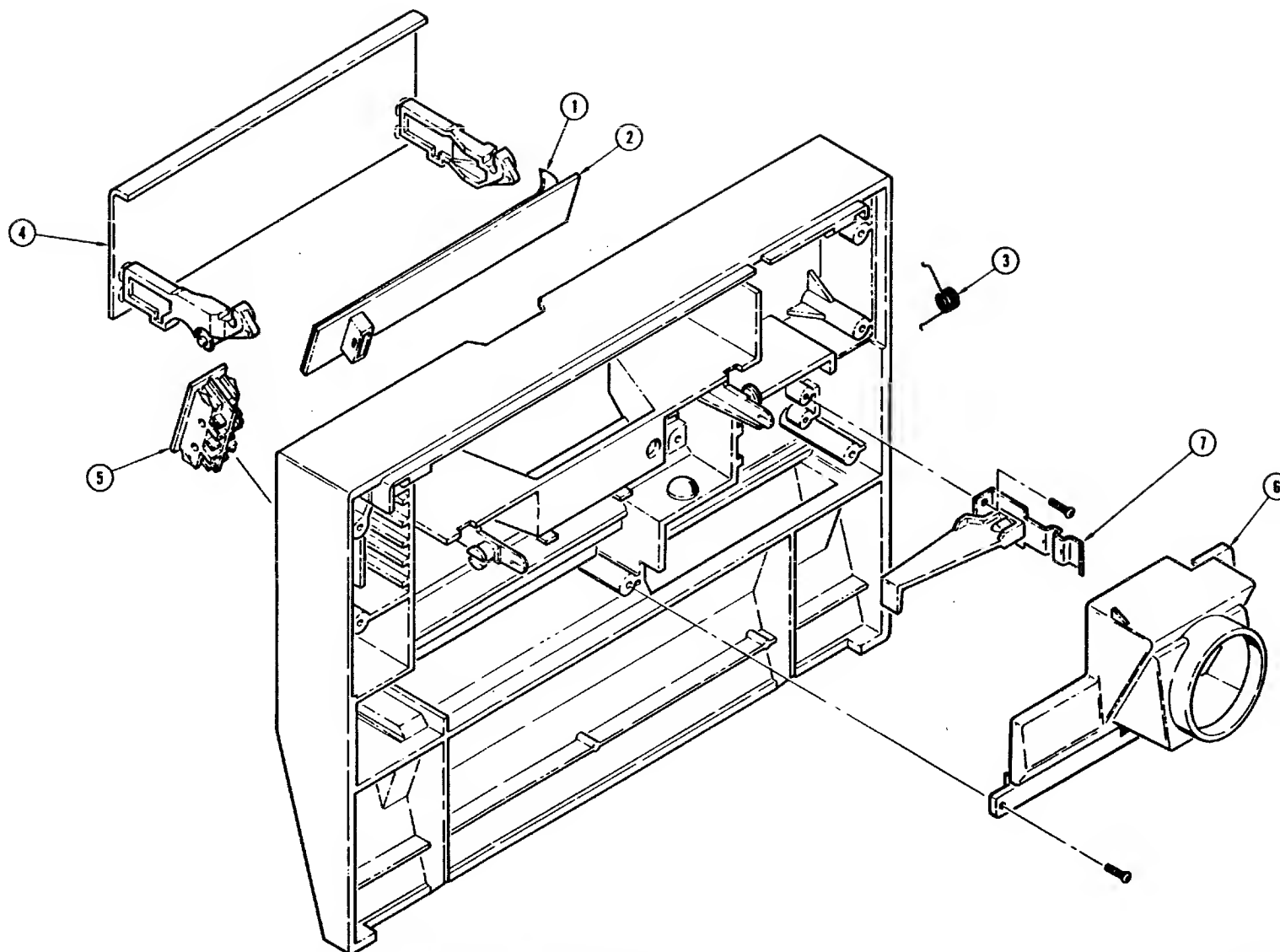


Figure 3-3. Front Panel Assembly (Exploded View)

Figure 3-3
Sheet 1 of 2

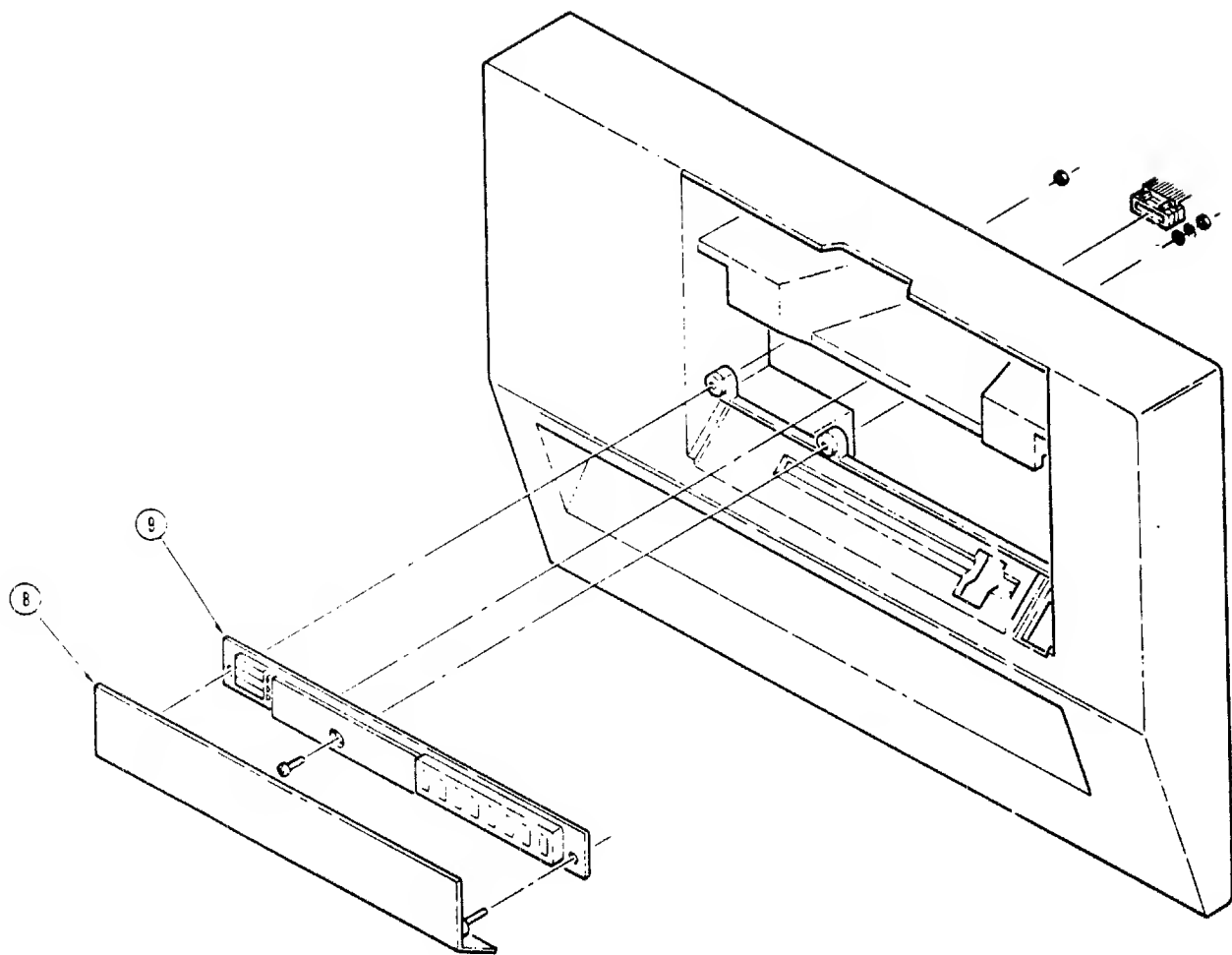


Figure 3-3. Front Panel Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
3-3	964145-001	FRONT PANEL ASSEMBLY (See Figure 3-1 for next higher assembly)	REF	
-1	961166-001	. FACIA, Touch Switch.....	1	
-2	961148-001	. TOUCH SWITCH, 6 position	1	
-3	961910-001	. SPRING, Filter side	1	
	961910-002	. SPRING, Switch side.....	1	
-4	964032-003	. DOOR ASSEMBLY	1	
-5	961348-001	. SWITCH, Power, DPDT, 16A, 250V	1	
-6	965052-001	. FILTER HOUSING.....	1	
-7	961266-002	. HANDLE, Rack latch	1	
-8	961140-001	. COVER, Display	1	
-9	961717-001	. PWB ASSEMBLY, Diagnostic display	1	

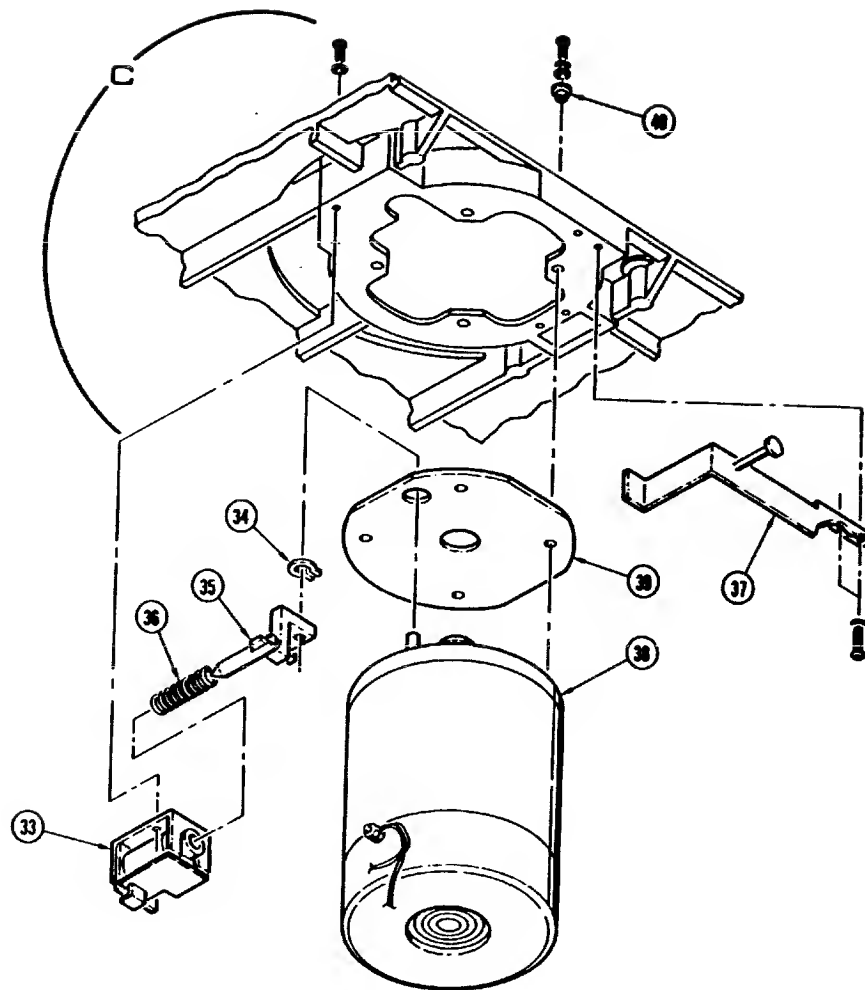
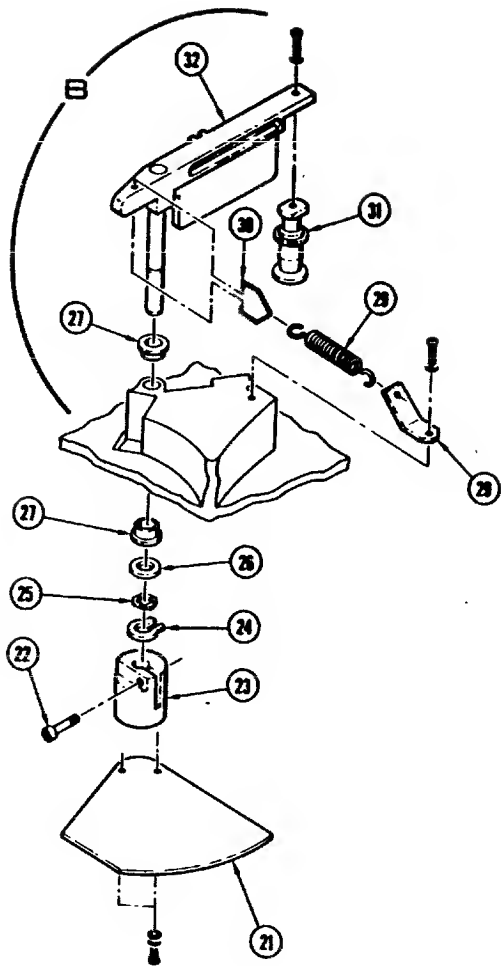


Figure 3-4. Basic Drive Assembly (Exploded View)

Figure 3-4
Sheet 2 of 3

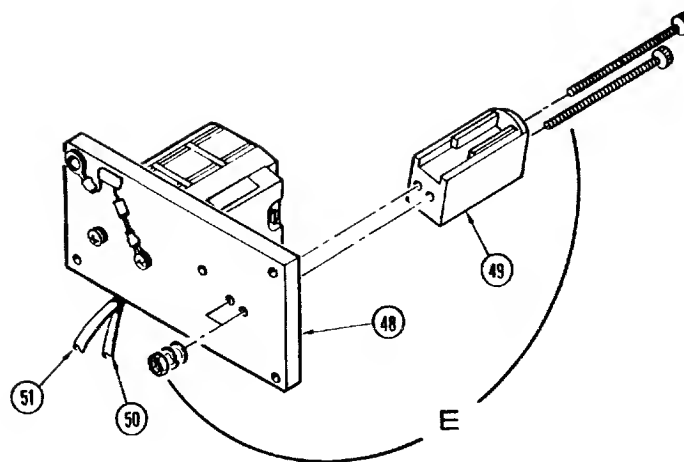
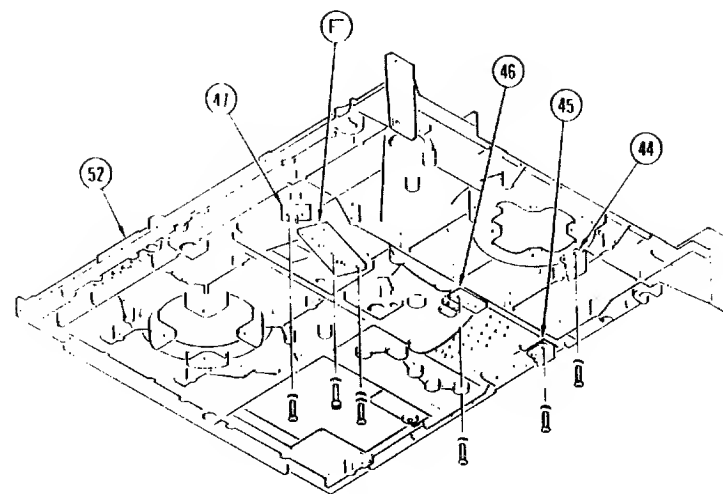
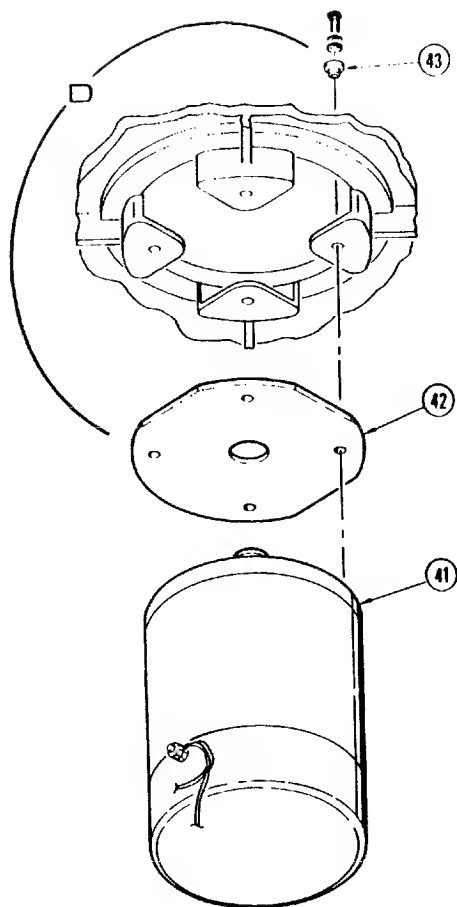


Figure 3-4. Basic Drive Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
3-4	960942-004	BASIC DRIVE ASSEMBLY (See Figure 3-1 for next higher assembly)	REF	
-1	760106-567	. HUB, Takeup	1	
-2	160101-406	. SUPPLY HUB ASSEMBLY	1	
-3	160103-433	. TAPE SENSOR ASSEMBLY, Molded.....	1	
-4	160106-479	. BUMPER ASSEMBLY	1	
	160106-478	. BUMPER ASSEMBLY	1	
-5	961699-001	. PRINTED WIRING BOARD ASSEMBLY..... Reflective sensor, EOT/BOT	1	
-6	962197-001	. SCREW, Captive, quick opening	2	
-7	962653-001	. SPRING, Compression, fastener	2	
-8	160105-433	. TACHOMETER ASSEMBLY.....	1	
-9	210200-032	. RING, Retaining, Push-On	1	
-10	210067-001	. BEARING, 1/4 x 3/8 in.	2	
-11	731911-102	. SHIM, .005 in. thick, 1/4 in. ID	AR	
-12	210008	. WASHER, Wave spring	1	
-13	205226-050	. RING, Grip, 1/4 in. ID	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
3-4				
-14	160101-471	CAPACITOR PLATE ASSEMBLY	1	
-15	961874 001 961874-002	POWER TRANSFORMER, MGCR..... TUV	1	
-16	961087-001	COVER ASSEMBLY, Power supply housing.....	1	
-17	961181-002	PWB ASSEMBLY, Power Supply	1	
-18	961604-001 961604-004	AIR PUMP ASSEMBLY..... TUV	1	
-19	961087-001	POWER SUPPLY HOUSING.....	1	
-20	961507-001	DOOR LOCK ASSEMBLY	1	
-21	760102-575	SHUTTER, Capacitor, Molded.....	1	
	160103-499	COMPLIANCE ARM ASSEMBLY	1	
-22	970938-405	SCREW, Torx	3	
-23	963430-001	HUB, Capacitor shutter	1	
-24	210200-032	RING, Retaining, external, 1/4 in.	1	
-25	210008	WASHER, Wave spring	1	
-26	731911-102	SHIM, 0.005 in. thick x 1/4 in. ID	1	
-27	210067-001	BEARING, 1/4 x 3/8 in.	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
3-4								
-28	760101-565	.	.	BRACKET, Spring, compliance arm			1	
-29	210006-010	.	.	SPRING, Extension			1	
-30	760101-554	.	.	CLIP, Spring			1	
-31	760104-500	.	.	TAPE GUIDE, Crowned roller, short			1	
-32	160104-492	.	.	ARM AND SHAFT ASSEMBLY			1	
-33	961666-001	.		HUB LOCK SOLENOID ASSEMBLY			1	
-34	210200-032	.		RING, Retaining			1	
-35	960745-001	.		BELLCRANK, Assembly			1	
-36	963188-001	.		SPRING, Compression			1	
-37	960930-001	.	.	BRACKET, Hub, Unlock				
-38	962747-001	.		MOTOR, Permanent magnet, 4 in.			1	
	963494-001	.		MOTOR, TUV (+37V), supply				
-39	760101-756	.		INSULATOR, Motor			1	
-40	760101-768	.		WASHER, Shoulder, insulating			4	
-41	961510-101	.		MOTOR, Permanent magnet,			1	
	962912-001	.		MOTOR, TUV (+37V), take up				

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABL ON CODE
3-4				
-42	760101-756	. INSULATOR, Motor	1	
-43	760101-768	. WASHER, Shoulder, insulating	4	
-44	960771-001	. PRINTED WIRING BOARD ASSEMBLY, File protect	1	
-45	160101-010	. PRINTED WIRING BOARD ASSEMBLY, Reflective sensor, Tape-In-Path	1	
-46	160104-401	. ROLLER GUIDE ASSEMBLY.....	1	
-47	160104-400	. ROLLER GUIDE ASSEMBLY.....	3	
-48	961960-001	. HEAD ASSEMBLY.....	1	
-49	131047-001	. TAPE SCRAPER ASSEMBLY	1	
-50	963809-001	. HEAD CABLE, READ.....	1	
-51	963808-001	. HEAD CABLE, WRITE	1	
-52	760106-547	. TOP PLATE	1	

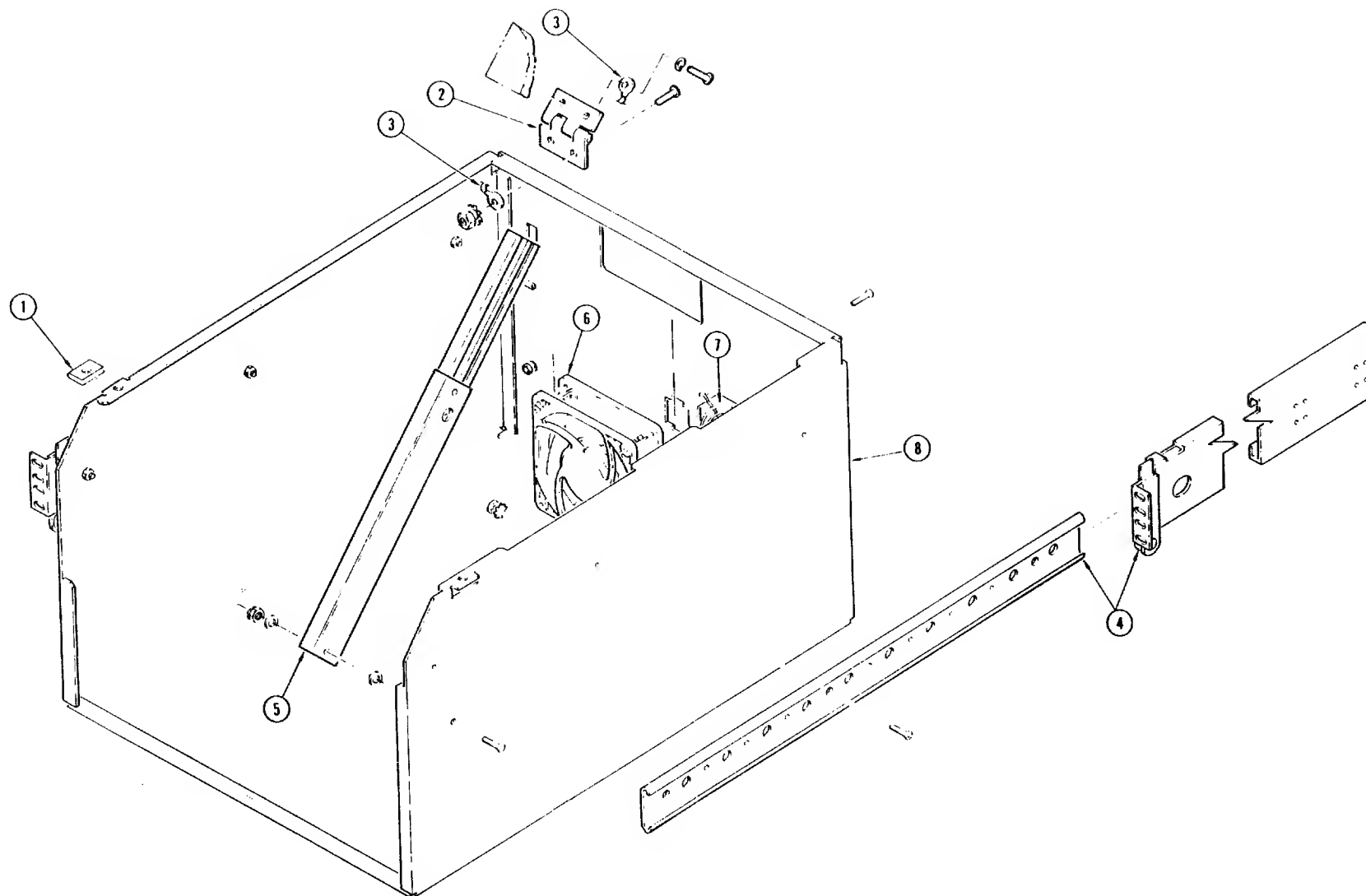


Figure 3-5. Chassis Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
3-5	960948-001	CHASSIS ASSEMBLY (See Figure 3-1 for next higher assembly)	REF	
-1	210116-027	. FASTENER, Clip-on	2	
-2	960238-001	. HINGE, Top Plate	2	
-3	962788-001	. GROUND STRAP, Chassis	1	
-4	961544-002	. SLIDE-CHASSIS, GCR Left	1	
	961544-001	. SLIDE-CHASSIS, GCR Right	1	
-5	963442-001	. SUPPORT MEMBERS, Assembly	1	
-6	970027-001	. FAN, AC, Axial, 4.5 sq.	1	
-7	970372-001	. GUARD, Finger, Fan	1	
-8	961078-001	. CHASSIS, MGCR	1	

Chapter 4. Diagnostic Tests and Troubleshooting

- CAUTION: This unit should be serviced by qualified maintenance personnel only.
- ACHTUNG: Dieses Gerät darf nur von Fachpersonal gewartet werden.
- CAUTION: If either the top cover or front tape loading door are forced open, moving mechanical parts may cause injury.
- ACHTUNG: Wenn der Klappdeckel oder die vordere Bandladetüre mit Gewalt geöffnet werden, besteht Gefahr der Verletzung durch die beweglichen Teile.

4.1 Diagnostic Test

The M990 tape unit has three separate types of built-in diagnostic tests.

1. Power-On Confidence Tests - Automatic power-on self diagnostic tests.
2. Series 100 Tests - Diagnostic tests **WITHOUT** a tape loaded.
3. Series 200 Tests - Diagnostic tests **WITH** a tape loaded.

The alphanumeric messages displayed during the diagnostic tests are shown below along with a brief description of each test.

4.1.1 Power-On Confidence Test

The power-on confidence test mode starts when the power is first switched on. During the power-on sequence, the number of the POC test that is being executed is displayed on the front panel.

The front panel indicators also illuminate with various patterns during the RAM test.

Note: Some tests run so fast that the test name i.e., POC 0, will not appear in the alphanumeric display unless that test fails. Normal operation will show, TESTING RAM, POC 1, POC 2, 88888,, ***** , and POC 5.

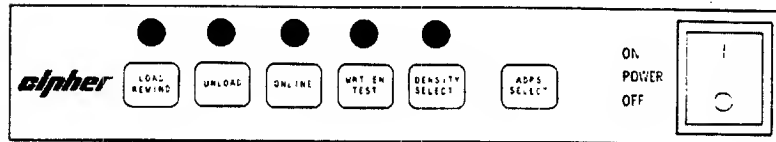
POC 0

This test checks both data and code RAM memory using a write/read and compare sequence of four patterns (FFFF, 5555, AAAA, 0000). The code RAM is checked first.

TESTING RAM

During the POC 0 test, the TESTING RAM message is displayed and the front panel indicators illuminate with various patterns.

RAM ERR



If the RAM ERR message is displayed and all of the front panel indicators remain lit, the unit failed to complete the RAM tests. Press any front panel switch to display a hex code (0000-FFFF) that indicates what area of RAM failed. The second activation of any front panel switch will display the reference designation of the faulty IC. Continue pressing the front panel switch until all faulty RAM IC reference designators are displayed. For example:

00FF

Press any switch. Indicates that the lower bank of RAM failed.

IC U21N

Press any switch again. Indicates that U21N is one of the faulty IC's.

POC 1

This test calculates the check sum for the four PROM memories U20K, U22K, U23K, and U25K.

CSE UXXK

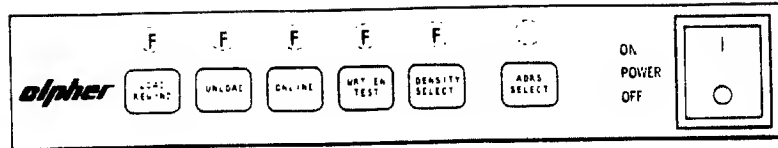
If the CSE UXXK message is displayed, POC 1 detected a check sum error on the indicated IC number. If more than PROM IC is faulty, its designator number will be displayed next.

POC 2

This test copies the data and code contained in the ROM's into the RAM memory, also resets the boot line.

88888888

.....



This test checks the alphanumeric display with three patterns; 88888888,, and *****, that alternate every 1/2 second. The front panel indicators also cycle continuously during this test.

POC 3

This test checks the contents of the NOVRAM. It performs a recall cycle on the NOVRAM, copies the information into RAM and performs an ecc check. If the ecc check fails completely, the NOVRAM is uninitialized and the default values are copied into the NOVRAM and the zero servo routine is called.

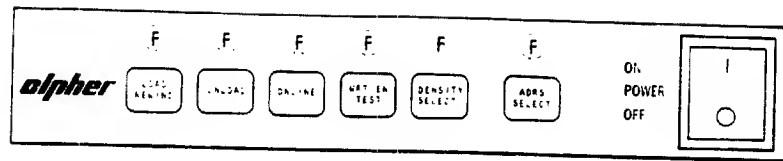
NVRM ERR

If the NVRM ERR message is displayed, the ecc routine corrected the erroneous bits. This message is displayed momentarily before the test continues.

POC 4

This test performs a fast check of the cache RAM by writing the patterns 1ff, 155, 099, and 000 in order into the first eight locations of each bank of cache RAM and then executing a read/compare operation.

CRAM ERR

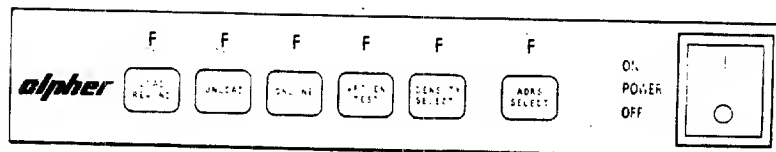


If the CRAM ERR message is displayed and all front panel indicators are flashing, the unit failed to complete the cache RAM test. Press the Load switch to display a hex code that indicates the section of cache RAM that failed. Press the Load switch again to display the reference designator of the faulty IC. Continue pressing the Load switch until all faulty IC reference designators are displayed. To exit the cache RAM test, press the Wrt En/Test switch.

POC 5

This test determines the phase quadrature of the tachometer and performs a pass/fail test by rotating the take-up hub in a clockwise direction for 200 milliseconds.

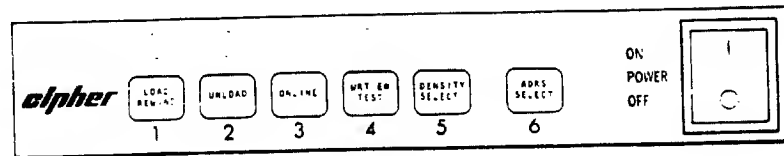
TACH ERR



If the TACH ERR message is displayed, the take-up hub moved less than .05 inch or 10 tachometer counts were not sensed.

4.1.2 Starting The Diagnostic Tests

Check to see that the On-Line indicator is off. If the indicator is on, press the On-Line switch to switch the unit to an off-line mode.



Note: Steps 2 through 5 must be accomplished within 3 seconds between keystrokes. If too much time is used, the GCR will automatically return to the normal operating mode.

1. Press the Wrt En/Test switch number 4.
2. Press the DENSITY SELECT switch number 5.
3. Press the switch numbers that represent the test to be run.
4. Press the DENSITY SELECT switch number 5 to **START** the diagnostic test.
5. Press the Wrt En/Test switch number 4 to **STOP** or cancel the diagnostic test.

Note: Some diagnostic tests require you to stop the test from running before you cancel the diagnostic.

When a diagnostic test is first entered, specific front panel indicators are lit to indicate the options available at this point. The diagnostic tests can operate in either the test execution mode or the parameter selection mode. The parameter selection mode allows you to select the operational parameters that are used when the test is run in the execution mode.

During the test, the alphanumeric display will display information about the drive's status.

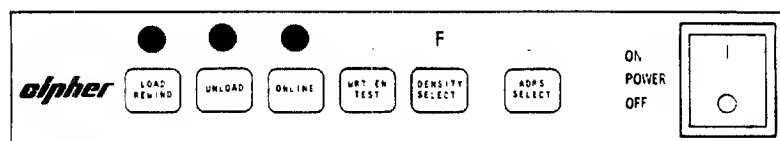
4.1.3 Diagnostic Tests WITHOUT Tape Loaded (Series 100)

CAUTION: Remove tape prior to running series 100 tests, failure to do so could cause damage to tape.

Test 111 (Oscillate Servos):

This test checks both the supply and take-up motors and their related servo circuits.

MODE ?



When entered, the test is in the parameter selection mode.

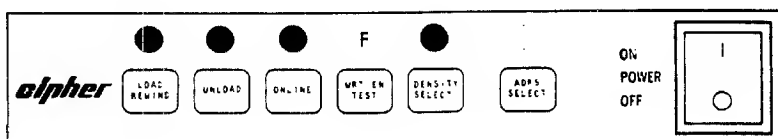
AUTO OSC Press the Load switch to select the auto-oscillate option. The initial speed is about 25 ips.

MAN SPLY Press the Unload switch to select the manual supply option with initial speed of 0 ips.

MAN TKUP Press the On-Line switch to select the manual take-up option. The initial speed is 0 ips.

Press the DENSITY SELECT switch to access the execution mode.

Note: Press and hold the Load switch during MAN SPLY or MAN TKUP mode to steadily increase speed up to 115 ips. Press and hold the Unload switch to decrease the speed to 0 and reverse direction. A positive drive value corresponds to clockwise rotation of the hub and negative drive value corresponds to counterclockwise rotation. The sequence is identical but opposite indirection if the Unload switch is pressed first. Press the On-Line switch to reverse the direction of rotation in the MAN SPLY, MAN TKUP, or AUTO OSC mode.

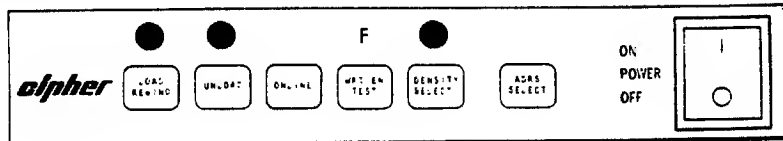


Test 124 (Voltage Display):

This test displays the analog voltage ($\pm 20\%$) of the following signal:

ARM Compliance arm output voltage

ARM + X.XX



The compliance arm voltage is displayed when the test is executed.

Test 125 (PROM Revision):

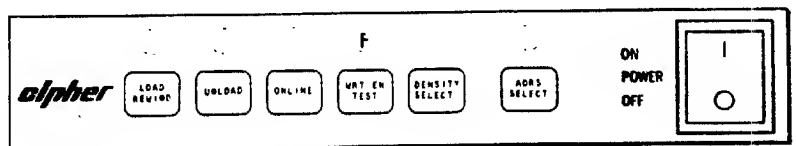
XXXXXX-XXX

This test displays the part number of the PROMs installed in the unit.

Test 131 (File Protect/Reel Seat, BOT, EOT, AND Tape-in-Path):

This test checks the status and operation of the file protect/reel seat, BOT, EOT, and Tape-in-Path sensor circuits.

The test begins by rotating the supply hub very slowly to allow the sensor to detect pulses reflected from the file protect and reel seat tabs. A reel of tape, with file protect ring inserted, must be placed on the supply hub (not loaded) and must be allowed to rotate freely. The display messages and corresponding actions are listed below:



This display occurs if there is no tape reel sensed on the supply hub. Exit the test and place the unit in the Operator Access Position (see para. 5.1). Place a tape reel on the supply hub and re-enter the test.

With a reel placed on the hub, as the reel seat tab passes the sensor the unload LED will flash twice. If the reel is write enabled, the LED will flash once as the write enabled tab passes the sensor, and twice for the reel seat sensor.

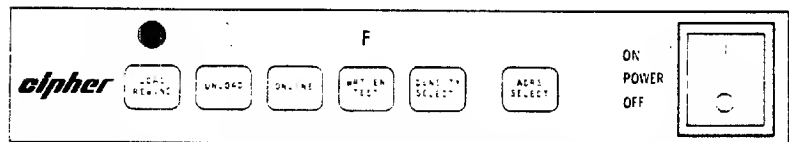
For BOT, EOT, and Tape-in-Path sensor, a strip of tape about three feet long with a BOT and EOT reflective strips placed on it. Remove the reel of tape from the supply hub and manually thread the piece of tape through the tape path.

B E T

Move the tape in front of the Tape-in-Path sensor, a "T" will be displayed on the alphanumeric display. As you move the BOT and EOT reflective strips past their respective sensors, a "B" or "E" will be displayed on the alphanumeric display.

Test 132 (Door and Hub Lock):

When entered, the test cycles both door lock and hub lock solenoids.



LOCKED

This display occurs when both front panel door and top cover are locked.

UNLOCKED

This display occurs if either the front panel door or top cover is open.

Press the Load switch to display the status of the door lock micro-switch.

SW OPEN

This message occurs when the solenoid is engaged.

SW CLOSED

This display indicates that the switch is in its normally closed (solenoid disengaged) position.

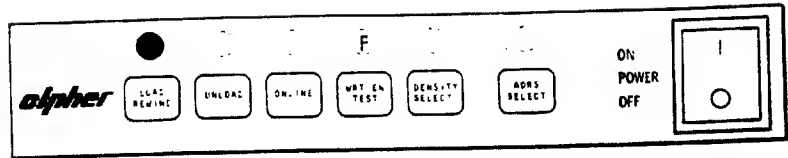
Test 133 (Door Open):

DR OPEN

This test deactivates the front panel and top cover lock solenoid so that the covers may be opened during the next load attempt. The DOOR OPEN message is displayed for 20 seconds.

Test 134 (Blower Motor):

BLWR ON



When entered, this test activates the blower motor.

BLWR OFF

Press the Load switch to turn the blower motor off.

BLWR ON

Press the Load switch again to turn the blower motor on.

To exit the test, press the Wrt En/Test switch.

Test 142 (Edit NOVRAM):

This test allows you to select the NOVRAM values to configure the M990 for efficient operation in your system. When first entered, the test will display the current value of the serial port baud rate parameter. The values of the configuration parameters can be displayed in the same order as the following list:

1. Option inactive
2. Host Supplied Parity - Yes, No
3. Echo Read Strobes - Yes, No
on Write
4. EOT Mode - Normal, T.I.
5. Forward Hitch Enabled - Yes, No
6. Echo 3200 bpi ID Burst - Yes, No
7. Option inactive -
8. Abort Active Writes - Yes, No
on Overwrites
9. Interface transfer Rate - 70.3, 79.1, 90.4,
(kHz) 105.5, 126.6, 158.2
211.0, 316.5, 632.8
10. Default Density - 1600, 6250, 3200
on Power-Up

11. Maximum Block - Size (k bytes)	9, 16, 32, 64
12. Interface Ramp Delay -	0 through 15
13. Write Sync Option -	DBLE FMK, SNGL FMK, NO W/S, ALL WRTS
14. Read Error Retries -	0, 3, 7, 11, 15
15. Write Error Retries -	0, 3, 7, 11, 15
16. Read Error Correction on -	Yes, No
17. Unit -	0 through 7
18. Lock Out 3200 bpi - Writes	Yes, No
19. Remote Density - Select Enabled	Yes, No
20. Report Corrected - Errors	Yes, No
21. Allow One Track Down - on Writes	Yes, No
22. 6250 Write Current - (read as XX.XX ma)	XXXX
23. 1600 Write Current -	XXXX
24. 3200 Write Current -	XXXX
25. 6250 RAW Threshold - (read as .XXX mv)	XXX
26. 1600 RAW Threshold -	XXX
27. 3200 RAW Threshold -	XXX
28. 3200/6250 BPI Select as 6250 BPI	Yes, No
29. Display "feet to EOT"	Yes, No
30. Write Error Override	Yes, No
31. Remote Load/On-Line	Yes, No

Press the Load switch to display the next parameter. If you press and hold the Load switch, the display will increment through the parameter list.

Press the Unload switch to display the previous parameter. Press and hold the Unload switch to decrement through the parameter list.

Press the On-Line switch to redisplay the current parameter.

To exit the test without changing any of the parameters, press the Wrt En/Test switch.

If you want to change a parameter value, select the appropriate number, using the Load or Unload switch, and enter the edit mode by pressing the DENSITY SELECT switch.

Note: Items 22 thru 27 are not alterable by test 142.

Press the Load switch to get a yes/no parameter value to yes, or increment a value parameter to its next higher value.

Press the Unload switch to set a yes/no parameter value to no, or decrement a value parameter to its next lower value.

To scroll the parameter name through the display, press the On-Line switch. The parameter value will remain in the display.

Press the DENSITY SELECT switch to return to the test execution mode.

To save the new parameter values and exit the test, press the Wrt En/Test and DENSITY SELECT switches together. These new values will be stored in the NOVRAM when the unit is powered down.

4.1.4 Diagnostic Tests WITH Tape Loaded (Series 200)

When entered, the diagnostic tests that move tape will default to the density/speed combinations shown below if the tape is write enabled. If the tape is write protected, the test will determine the density/speed combination that is compatible with the data written on the tape. The density is displayed on the front panel LED's.

Model M990: 1600bpi/100ips

3200bpi/50ips

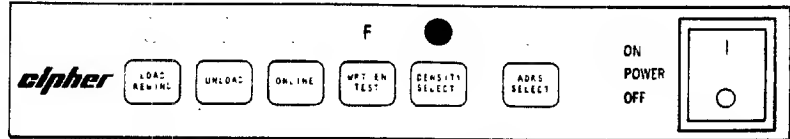
6250bpi/70ips

Test 212 (Read/Write Data):

This test writes 16 bytes of data per block incrementing from 01 to 0F on the tape, if write enabled, until EOT is detected, then reads reverse to BOT. No error correction attempts are made during this test. The data is written at the density indicated by the front panel LEDs.

If the tape is write protected, the drive will read forward to EOT, then read reverse to BOT until the test is terminated.

TEST 212



WRITING

This message is displayed if the tape is **write enabled**. Press the **DENSITY SELECT** switch to **reverse** direction if the tape is moving forward. Press the **WRT EN/TEST** switch to rewind to BOT and exit the test.

RUN FWD

The RUN FWD message is displayed if the tape is not write enabled. Press the Wrt EN/TEST switch to rewind to BOT and exit the test. Press the DENSITY SELECT switch once to stop tape movement, and a second time to cause a read reverse.

READ REV

The READ REV message is displayed if the tape is write enabled. Press the WRT EN/TEST to rewind to BOT and exit the test. Press the DENSITY SELECT switch once to stop tape movement, and a second time to cause a read forward.

RUN REV

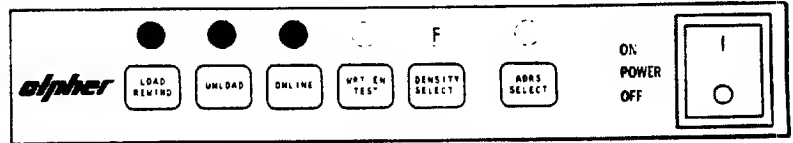
The RUN REV message is displayed if the tape is not write enabled. Press the Wrt EN/TEST to rewind to BOT and exit the test. Press the DENSITY SELECT switch once to stop tape movement, and a second time to cause a read forward.

Note: Tape must be moving to exit this test. If the tape is not moving, press the DENSITY SELECT switch to start tape movement, then press the Wrt EN/TEST switch to exit the test.

Test 222 (Tape Shuttle):

This test runs the tape forward and reverse for the amount of time selected in the parameter selection mode. There is no data transfer during this test.

SELECT FWD/REV
TIME IN SECONDS



When entered, the test is in the parameter selection mode.

.5/.2

Press the Load switch to run tape forward for .5 seconds and reverse for .2 seconds.

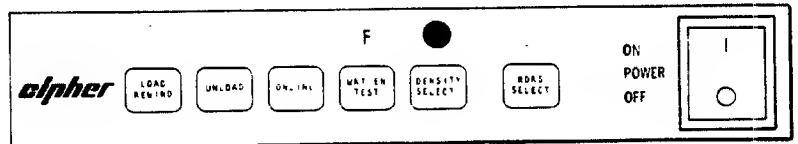
2/1

Press the Unload switch to run tape forward for 2 seconds and reverse for 1 second.

10/5

Press the On-Line switch to run tape forward for 10 seconds and reverse for 5 seconds.

Press the DENSITY SELECT switch to execute the test, if no time periods were selected, the tape will rewind to BOT and the test will terminate.



Test 223 (Read/Write Check):

This test cycles through the following sequence of operations until exited.

WRITING

The unit writes blocks of data forward to EOT. Write retries are performed and the number of write errors are recorded.

READ REV

The unit reads reverse to BOT and compares the read data with the write data of the previous operation. Read retries are performed as part of this test.

READ FWD

The unit next reads forward to EOT and performs a read/write data compare check with read retries.

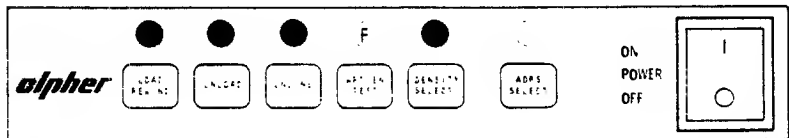
REWIND'G

The unit rewinds tape to BOT.

The unit increments the density to the next higher value, i.e., if the present density is 1600 bpi it increments to 3200 bpi.

The test increments the pass count by one and repeats the above loop.

TAPE MUST BE
WRITE ENABLED



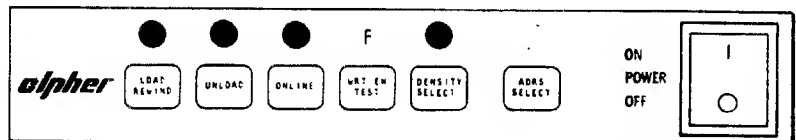
When entered, the tape loaded on the unit must be write enabled to allow test to continue.

Press the Load switch to increment to the next operation in the cycle, i.e., writing to Read Rev, Read Rev to Read Fwd, and Read Fwd to Rewind.

Press the Unload switch to abort the current operation, rewind and switch to the next density.

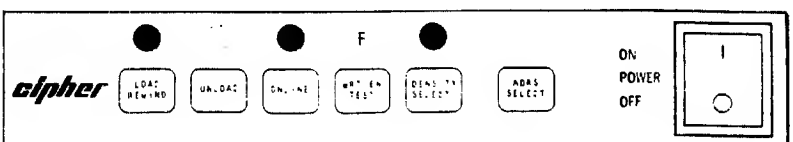
Press the On-line switch to lock or unlock the option to switch to the next density at the end of the read forward operation.

UNLOCKED



Default condition is Unlocked when entering the test. By pressing On-line once, 'LOCKED' will be displayed and you will continuously cycle in the current density until On-line is pressed again or the test is terminated.

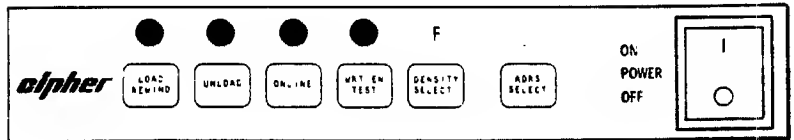
LOCKED



Press the Wrt En/Test switch to rewind the tape to BOT and enable the status mode.

Press the DENSITY SELECT switch to enable the status mode at any point on the tape.

STATUS



This display occurs when the test is in the status mode.

TOTAL

Press the Load switch to display the total errors that occurred during this test in all three densities.

1600 BPI

Press the Unload switch to display the errors that occurred in the 1600 bpi mode.

3200 BPI

Press the On-line switch to display the errors that occurred in the 3200 bpi mode.

6250 BPI

Press the Wrt En/Test switch to display the errors that occurred in the 6250 bpi mode.

The errors are displayed in the following sequence:

P A S S

This message represents the number of passes the test has completed.

H D E N

This message represents the number of hard errors.

C R E N

This message represents the number of corrected errors.

WT Tn

This display indicates the number of write retries.

RD Tn

This display indicates the number of read retries.

TRK ERRS

TRK tn

This message represents the error history of each track (t) 0 through 7, P.N. indicates the number of errors for each track. Only tracks with errors are displayed.

TOT 1600

TOT 3200

TOT 6250

These messages represent the sum of the previous errors that occurred with the unit operating at the indicated density. These will be displayed only if the total error display mode is selected.

Press the Wrt En/Test switch to rewind tape and enter the status mode. Press the DENSITY SELECT switch to exit the test.

Test 224 (Voltage Display):

Same as test 124, but with tape loaded.

Test 233 (Door Open):

DR OPEN

This test disengages the top-cover/front-panel lock. The DR OPEN message is displayed for 20 seconds. The tape must be at BOT.

Test 242 (Edit Novram):

Same as test 142 except that tape is loaded on unit during test.

Test 243 (No Write Retries):

WRT RETRIES OFF

This test disables the write retry circuit.

Note: To return the write retry circuit to normal operation, the ac power switch must be turned off then on.

Test 244 (Infinite Read/Write Retries):

WRT/RD RTRYS = 64K

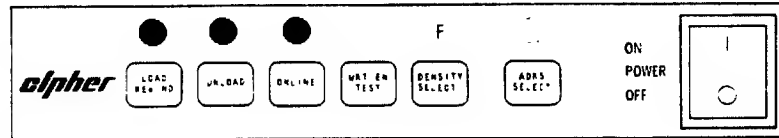
This test set both the write and read retries to 64K.

Note: To return the write retry circuit to normal operation, the ac power switch must be turned off then on.

Test 255 (Display Status):

This test displays the following error history information. The error history can be compiled during on-line operation or diagnostic tests that read and write data.

STATUS



HRD ERRS
COR ERRS

Press the Load switch to display the number of hard errors and corrected errors.

WRT TRYS
RD TRYS

Press the Unload switch to display the number of write retries, then the number of read retries.

TRACK ERROR
HISTORY

Press the On-line switch to display the error history of each track as TRK (t) (n) where (t) is the track number 0 through 7, and (n) is the number of errors. (Tracks without errors are not displayed.) If no errors have occurred, the message 0 ERRORS is displayed. Press 'Test' to display clear error history, followed by Yes/No. Press Load select for Yes or Unload select for No. Pressing density will execute your selection.

Press the DENSITY SELECT switch to exit the test.

4.2 Troubleshooting

The purpose of this section is to assist in repairing common faults through some simple tests designed to find the field replaceable subassembly that is causing the problem. The section is divided into three sub-sections: the Troubleshooting, Main Tests and Common Tests.

Troubleshooting

This section explains how to troubleshoot the M990 using this chapter and general information which is required to be known by the technician prior to troubleshooting.

Main Tests

This section contains all the tests used to find the source of the problem. It is divided into four areas: power up failures, load faults, operational faults, and data related errors.

Common Tests

Some subassemblies can cause more than one type of error, but the test is always the same. These tests are grouped together in this section. In the main tests section, a common test is shown by enclosing it inside parenthesis as "(common test)". Some of the common tests also refer to other common tests.

It is intended that this section be used by a technically skilled person who is familiar with the GCR tape unit and the diagnostics available on the machine. For more information on the GCR diagnostics, see section 4.1.

4.2.1 Using This Section -

1. Before doing anything, make a thorough visual inspection of the drive. Look for loose or damaged connectors and make sure that all the boards are seated properly. Also look for any damage to the backplane connectors or cables.
2. Find the type of problem the drive is having in the list below.

Problem type	Table
Power up failures	1
Load faults	2
Operational faults	3
Data related errors	4

3. Refer to the appropriate table (see pages 4-22 and 4-23) to further classify the problem.
4. Find the symptom or error message you are seeing in the table. Error messages are shown inside double quotes, e.g., "FRONT PANEL MESSAGE".
5. Go to the page listed in the "Page" column and follow the test procedure listed under "Test".

Example -

Suppose the drive won't load tape and the front panel display shows "LOAD FAILURE". In the table above we find "Load faults". The right hand column refers us to Table 2. In Table 2 we find "LOAD FAILURE" close to the bottom of the table. The right hand columns tells us to follow test B-9 to find the failing sub-assembly.

6. If you replace or repair anything, start the test over from the beginning unless told to do otherwise. (See the following section on changing boards.)
7. If after following the test procedure the problem continues, replace the backplane.

Recording NOVRAM values -

Record the values stored in the NOVRAM somewhere so you can check them and make sure someone has not changed them accidentally.

4.2.2 Changing boards

To change any of the four main boards, use the following procedures. Anytime you change a board, check the connector on the backplane before pulling the board out. If you notice the backplane is damaged, try fixing it before swapping out the board.

4.2.2.1 Sense Servo Board

1. Zero the servo offsets using procedure 5.34.4.
2. Run Test 513 to set the Read/Write threshold.

4.2.2.2 CPU Board

1. Record the current NOVRAM values.
2. Run Test 542 to set drive to Internal Mode.
3. Enter Test 525 to set the default values in the NOVRAM. The display will read "INITIALIZE NOVRAM TO". Press the UNLOAD switch and "FIELD" will be displayed. Press the DENSITY SELECT switch to exit the test.
4. Run Test 542 to set the drive back to Field Mode.
5. Edit the NOVRAM using Test 142 and insert the values recorded in step 1.
6. Zero the servo offsets using procedure 5.34.4.
7. Run Test 513 to set Read/Write threshold.

4.2.2.3 Data board

1. Run Test 513 to set Read/Write threshold.

4.2.2.4 CIF Board

1. Run Test 513 to set Read/Write threshold.

4.2.3 Notes and Cautions

1. Using a digital voltmeter may give misleading readings when measuring voltages across the motors. Use Triplet model 630 NA, Fluke Model 77 or equivalent.
2. Be sure to turn the power off and wait for 10 seconds before removing or installing any boards.

<u>Symptom or Message</u>	<u>Test</u>
No alpha dsp, power light doesn't come on	A-1
No alpha dsp, power light on steady	A-2
All front panel LED'S on steady	A-3
"POC 0"	A-4
"TESTING RAM"	A-5
"POC 1"	A-6
"POC 2"	A-7
"POC 3"	A-8
"NVRM ERR"	A-9
"POC 4"	A-10
"POC 5"	A-11

Table 1. Power up failures.

<u>Symptom or Message</u>	<u>Test</u>
"ARM FAULT DURING LOAD"	B-1
"HUB SEAT"	B-2
"NOT ENOUGH TAPE ON TAKEUP" (Man. load)	B-3
"TAPE STUCK"	B-4
"NO DOOR LOCK"	B-5
"SERVO FAILURE"	B-6
"REEL UPSIDE DOWN"	B-7
"NO BOT"	B-8
"LOAD FAILURE"	B-9
During auto load, takeup doesn't turn	B-10
Pawls don't lock	B-11
Run away during auto load	B-12

Table 2. Load faults

<u>Symptom or Message</u>	<u>Test</u>
Interface timeout	C-1
Online but won't respond to commands	C-2
Blower won't come on.....	C-3
"ARM FAULT DURING RU"	C-4
"NO BOT" or Misses EOT or BOT	C-5
Doesn't sense write protected tape	C-6
Breaks tape	C-7
Destroys tape.....	C-8
"TAPE LENGTH 3700 FT"	C-9
"18 FT PAST EOT"	C-10
"ARM FAULT DURING LOAD"	C-11
"SPEED ERROR".....	C-12
"CACHE RAM PARITY ERR"	C-13
Problems with impending EOT	C-14
Won't knock pawls down.....	C-15
Buttons don't work	C-16
Display doesn't work	C-17
Can't sense open door	C-18

Table 3. Operation faults

<u>Symptom or Message</u>	<u>Test</u>
Mispositions	D-1
Excessive repositioning	D-2
Excessive write retries.....	D-3
Excessive read retries	D-4
"BLOCK SIZE ERROR"	D-5
"VRC ERR"	D-6
Record length errors.....	D-7
Can't interchange tapes	D-8
"WRITE EDIT ERR"	D-9
Data errors.....	D-10
Continuous hard errors at host	D-11
Host detected misposition	D-12
Unit selects incorrect density for read	D-13

Table 4. Data related errors

4.3 Main Tests

Note - See section 4.4 for tests that are shown inside parenthesis, "()".

As the GCR evolved, the Printed Wiring Boards were improved, resulting in several "sets" of boards being produced. The table below identifies which PWB Set a particular board belongs to based on the first six digits of its part number. Be sure to use the appropriate instructions for the board you are troubleshooting.

PWB	PWB Set A	PWB Set B	PWB Set C
S/S-37V		962810-XXX	963491-XXX
S/S-57V	961344-XXX	962832-XXX	963490-XXX
CPU	961730-XXX	962112-XXX	963394-XXX
Data	961420-XXX	962789-XXX	963674-XXX
CIF	961346-XXX	962357-XXX	962357-XXX

4.3.1 Tests for Power Up Failures

- A-1. No alpha display, power light does not turn on.
 - a. Check (Power supply).
- A-2. No alpha display, power light on steady. Same as A-3 below.
- A-3. All front panel LED's on steady.
 - a. Check (Harness) to front panel and all Sense Servo connectors.
 - b. Cycle power while monitoring the reset line on TP-14, PWB Set A, or U11C Pin 7, PWB Set B, on Sensor/Servo board. Does reset change from high to low and remain low?
 - Yes - Continue at step c.
 - No - Continue at step f.
 - c. Check (Power supply). Is it ok?
 - Yes - Continue at step d.
 - d. On the CPU board, monitor CPU clock TP-11, PWB Sets A, B, and C, with an oscilloscope. Is the clock toggling up and down?
 - Yes - Continue at step e.
 - No - Replace CPU board.
 - e. On the CPU board, check U25B pins 1 through 5, 8, 9, and 32 through 40, PWB Sets A and B; check U25C, same pins, for PWB Set C. Are the data lines going up and down?

Yes - Continue at step g.

No - Replace CPU board.

f. Check (Power supply). Is it ok?

Yes - Replace Sensor/Servo board.

g. On the CPU board, check the vectored interrupts on U25B pin 11, PWB Sets A and B; U25C Pin 11, PWB Set C. Is there a negative pulse approximately every 1 millisecond?

Yes - Continue at step h.

No - Replace CPU board.

h. Turn off power. Pull out the Data and CIF boards. Power up the drive. Does the drive power up normally now?

Yes - Continue at step i.

No - Replace Sensor/Servo board.

i. Turn off the power, and reinstall Data board. Does the drive power up normally now?

Yes - Replace the CIF board.

No - Replace the Data board.

A-4. POC 0.

a. Replace CPU board.

A-5. TESTING RAM.

a. Replace CPU board.

A-6. POC 1.

a. Replace CPU board.

A-7. POC 2.

a. Replace CPU board.

A-8. POC 3.

a. Replace CPU board.

A-9. NVRM ERR.

a. Replace CPU board.

- b. Recalibrate servo using Servo Offset adjustment procedure 5.34.4 of Maintenance Manual.
- c. Enter the recorded values in the NOVRAM.

A-10. POC 4.

- a. Replace CPU board.

A-11. POC 5.

- a. Check (Tach assembly). Is it ok?
Yes - Continue at step b.
- b. Check (Takeup motor).

4.3.2 Tests for Load Faults

B-1. Arm fault during autoload.

- a. Check (Arm assembly).
- b. Check (Supply motor).
- c. Check (NOVRAM offset).

B-2. Hub Seat Failure.

- a. Check (File protect / reel seat) sensor.
- b. Check (NOVRAM offset).

B-3. Not Enough Tape on Takeup (Manual load only)

- a. Check (Tach assembly).
- b. Check (NOVRAM offset).

B-4. Tape Stuck.

- a. Check (Tape in path) sensor.
- b. Check (NOVRAM offset).

B-5. No Door Lock.

- a. Check (Door lock).

B-6. Servo Failure.

- a. Check (Supply motor).
- b. Check (NOVRAM offset).

- B-7. Reel is upside down.
 - a. Check (Tape in pat) sensor.
- B-8. No BOT.
 - a. Check (EOT / BOT) sensor.
- B-9. Autoload failure after 4 tries.
 - a. Check tape leader. Is it smooth and unwrinkled, and has the end been trimmed with the tape trimmer?
 - Yes - Continue at step b.
 - No - Repair tape leader.
 - b. Cycle power. Do you get a POC 5 error?
 - Yes - See A-11.
 - No - Continue at step c.
 - c. Check (Supply motor).
 - d. Check (Blower motor).
 - e. Check (NOVRAM offset).
- B-10. During autoload, Takeup Motor does not turn.
 - a. Check (Takeup motor).
 - b. Check (NOVRAM offset).
- B-11. Pawls do not lock.
 - a. Check (Supply motor).
 - b. Check (Hub lock).
 - c. Check (NOVRAM offsets).
- B-12. Run away during autoload.
 - a. Check (Tach assembly). Is it ok?
 - Yes - Replace Sensor/Servo board.

4.3.3 Tests for Operational Faults

- C-1. Interface timeout.
 - a. Replace CIF board.

- C-2. Online but does not respond to commands.
 - a. Replace CIF board.
- C-3. Blower does not come on.
 - a. Check (Blower motor).
- C-4. Drops tape during rewind.
 - a. Cycle power. Do you get POC 5 error?
 - Yes - See A-11.
 - No - Continue at step b.
 - b. Check (Arm assembly).
 - Yes - Replace Sense/Servo board.
- C-5. Misses EOT or BOT.
 - a. Check (EOT/BOT).
- C-6. Does not sense write protected tape.
 - a. Check (File protect / reel seat) sensor.
- C-7. Breaks tape.
 - a. Replace Sensor/Servo board.
- C-8. Destroys Tape.
 - a. Check tape path (Hub height, roller guides, Tach Arm).
 - b. Clean Head and Rollers.
 - c. Check head for nicks or dings.
 - d. If problem is finning (uneven tape pack on the takeup reel), check tach roller or roller guide near the take-up reel for damage. If roller wear looks uneven, replace tach assembly.
- C-9. Tape length greater than 3700 feet.
 - a. Check (Tach assembly).
- C-10. 18 feet past EOT.
 - a. Check (EOT / BOT) sensor.
- C-11. Arm fault during run.

- a. Check (Arm assembly).

C-12. Speed error.

- a. Check (Tach assembly).
- b. Check (Takeup motor).
- c. Run test 212 while monitoring on the Data board Pin 13 of U5B for PWB Set A; U12B Pin 13 for PWB Sets B and C. Is there a positive pulse approximately every 7 milliseconds?

No - Replace the Data board.

Yes - Replace Sensor/Servo board.

C-13. Cache RAM parity error.

- a. Replace CPU board.

C-14. Problems with impending EOT.

- a. Check (File protect / reel seat) sensor.

C-15. Does not retract pawls.

- a. Check (Hub lock).
- b. Check (Supply motor).

C-16 Front panel switches do not work.

- a. Check (Harness). Is it ok?
Yes - Continue at step b.
- b. Replace Sensor/Servo board. Problem fixed?

Yes - PASS.

No - Replace front panel switches.

C-17. Display does not work.

- a. Check (Harness).
- b. On the Sensor/Servo board, measure +5 volts for the display board at R163 for PWB Set A; U14F-10 for PWB Set B; and U11C-10 for PWB Set C. Is it between 4.85 to 5.15 volts?

Yes - Continue at step c.

No - Replace Sensor/Servo board.

- c. Run test 143. On the Sensor/Servo board, PWB Set A, trigger the scope on the negative edge of the clock pulse on U16G pin 11. Check for data at U12G pins 3, 6, 8, 11 and U13G pins 3, 6, and 11. Are they toggling up and down? On the Sensor/Servo board, PWB Set B, trigger the scope on the negative edge of the clock pulse on U12F pin 8. Check for data at U14E Pins 3, 6, 8, and 11, and U14F pins 3, 8, and 11. Are they toggling? On the Sensor/Servo board, PWB Set C, trigger the scope on the negative edge of the clock pulse at U10F pin 8. Check for data at U11C pins 3, 6, 8, and 11, and U11D pins 3, 6, and 11. Are they toggling?

Yes - Replace display board.

No - Replace Sensor/Servo board.

C-18. Does not sense open door.

- a. Check (Door lock).

4.3.4. Tests for Data Related Errors

D-1. Mispositions.

- a. Check (Read threshold).
- b. Replace Sensor/Servo board.

D-2. Excessive repositioning.

- a. Check (File protect / reel seat) sensor.
- b. Replace Sensor/Servo board. Does problem go away?

Yes - Pass.

No - Continue at step c.

- c. Unless the transfer rate in the NOVRAM is at its maximum value, step it to the next higher rate (refer to section 4.1.3.) When you move data through the interface, do you get VRC, record length errors, or some other type of data error?

Yes - Lower the transfer rate one step.

No - Repeat step b above.

D-3. Excessive write retries.

- a. Check (Common data problems).
- b. Clean the tape scraper. Repeat test with a new reel of tape.

D-4. Excessive read retries.

- a. Check (Common data problems).

D-5. Block size error.

- a. Are you sure that the block size on tape is less than 64K?

Yes - Replace CPU board.

No - Continue at step b.

- b. Check (Common data problems).

D-6. VRC error.

- a. Check (Common data problems).

- b. Replace the CIF board. Does problem go away?

Yes - PASS

No - Continue at step c.

- c. Replace the CIF board with the one you took out, then replace the Data board. Does this fix the problem?

Yes - PASS.

No - Continue at step d.

- d. Replace the Data board with the one you took out, then replace the CPU board.

D-7. Record length errors.

- a. Check (Common data problems).

- b. Replace the CPU board. Does problem go away?

Yes - PASS.

No - Continue at step c.

- c. Replace the CPU board with the one you took out. Replace the CIF board. Does this fix the problem?

Yes - PASS.

No - Continue at step d.

- d. Replace the CIF board with the one you took out. Replace the Data board.

D-8. Cannot interchange tapes. There are two types of failures for this problem. See (1) and (2) below for the one that applies.

(1) Does not read other drives tapes.

a. Check (Common data problems).

b. Replace Data board. Does this fix the problem?

Yes - PASS.

No - Continue at step c.

c. Replace the Data board with the one you took out. Replace the CIF board.

(2) Other drives cannot read the tapes written on this drive.

a. Check (Common data problems).

b. Replace CIF board.

D-9. Write edit error.

a. This problem is most often caused by the host command sequence not matching the GCR command sequence specifications. See the installation manual for more information.

b. Replace the CIF board.

D-10. Data errors.

a. Check (Common data problems).

b. Replace the Data board. Does problem go away?

Yes - PASS

No - Continue at step c.

c. Replace the Data board with the one you took out, then replace the CPU board. Does problem go away?

Yes - PASS

No - Continue at step d.

d. Replace the CPU board with the one you took out, then replace the CIF board.

D-11. Continuous hard errors at host.

a. Check (Common data problems).

- b. Replace the CIF board.

D-12. Host detected misposition or wrong record ID.

- a. Replace Sensor/Servo board. Does problem go away?

Yes - PASS.

No - Continue at step b.

- b. Replace the Sensor/Servo board with the one you removed, then replace the Data board.

D-13. Unit selects incorrect density for read.

- a. Check (Common data problems).

- b. Replace the Data board. Does problem go away?

Yes - PASS

No - Continue at step c.

- c. Replace the Data board with the one you took out, then replace the Sensor/Servo board.

4.4 Common Tests

The following table identifies the common tests listed in this section along with the page number of the test.

	Test	Page
4.4.1.	Arm assembly	4-32
4.4.2.	Blower motor	4-32
4.4.3.	Door lock	4-33
4.4.4.	EOT / BOT	4-33
4.4.5.	File protect / reel seat	4-34
4.4.6.	Harness	4-34
4.4.7.	Hub lock	4-34
4.4.8.	Novram offset	4-35
4.4.9.	Power supply	4-35
4.4.10.	Supply motor	4-36
4.4.11.	Tach assembly	4-38
4.4.12.	Takeup motor	4-38
4.4.13.	Tape in path	4-39
4.4.14.	Common data problems ...	4-40
4.4.15.	Read threshold	4-40
4.4.16.	Set Internal/Field	4-41
	Mode (test 542)	
4.4.17.	Automatic Write Current Calibration (test 513)	4-42

4.4.1 Arm assembly

Does the arm bind when you move it?

1. Yes - Perform visual inspection for anything interfering with arm movement.

No - Continue at step 2.

2. Enter test 124. Pull the arm back to its stop while watching voltage on front panel display. Does the voltage change?

Yes - Continue at step 3.

No - Continue at step 4.

3. Record the voltage at rest, record the voltage at full arm travel. Is the difference between the two at least 2 VDC, but no more than 12.5 VDC?

Yes - PASS.

No - Replace Sensor/Servo board.

4. Check (Harness). Is it ok?

Yes - Replace Sensor/Servo board.

4.4.2. Blower motor

1. Enter test 134. Can you hear the blower come on?

Yes - PASS.

No - Continue at step 2.

2. Check Sensor/Servo board for blower signal at R35 for PWB Set A; J1-5 for PWB Set B and Set C. The signal drops from +12V to +5V when the motor is activated with PWB Set A, and from +5V to 0 with PWB Set B or Set C.

Yes - Continue at step 3.

No - Replace Sensor/Servo board.

3. Turn off the power. Check voltage from power supply to blower by unplugging the P4 connector (a small, 3 position connector next to the blower motor). Place a AC voltmeter on pins 1 and 2 (female part of connector). Do you measure 110-140 Vac?

Yes - Replace blower motor.

No - Replace power supply.

4.4.3. Door lock

1. Open the front door and the top cover of the drive. Enter test 132. Looking through the opening between the front panel and the top plate on the left side of the drive, can you see the door lock solenoid pulling in then releasing, and does the display show "UNLOCKED"?

Yes - Continue step 3.

No - Continue at step 2.

2. Check (Harness). Is it ok?

Yes - Replace Sensor/Servo board.

3. Press load button. Display should show "SW CLSD". Close both top cover and front door. Press load. Does drive show "LOCKED"?

Yes - PASS.

No - Replace door lock assembly.

4.4.4. EOT/BOT

1. Enter test 131. Place a tape marker in front of the BOT sensor in approximately the same place as the tape would hold it. Does the LOAD LED come on?

Yes - Continue at step 2.

No - Continue at step 3.

2. Place tape marker in front of the EOT sensor. Does the UNLOAD led come on?

Yes - PASS.

No - Continue at step 3.

3. Check (Harness). Is it ok?

Yes - Continue at step 4.

4. On the Sensor/Servo board, check R122 on PWB Set A, R195 on PWB Set B, or R150 on PWB Set C for +5 Vdc to sensor. Is the voltage between 4.85 and 5.15 Vdc?

Yes - Replace EOT/BOT sensor.

No - Replace Sensor/Servo board.

4.4.5 File protect / reel seat

1. Place a write enabled reel of scratch tape in the drive. Enter test 131. Observe the "UNLOAD INDICATOR" comes on.

Yes - PASS.

No - Continue at step 2.

2. Is the (Harness) ok?

Yes - Continue at step 3.

3. Measure power to sensor on Sensor/Servo board at R118 for PWB Set A, R270 for PWB Set B, or R149 for PWB Set C. Is it between 4.85 to 5.15 Vdc?

Yes - Replace file protect / reel seat sensor.

No - Replace Sensor/Servo board.

4.4.6. Harness

1. Check the harness where it connects with the sub-assembly under test. Is the connection ok?

Yes - Continue at step 2.

No - Repair or replace harness.

2. Check the harness where it connects with the Sensor/Servo board. Is the connection ok?

Yes - PASS.

No - Repair or replace harness.

4.4.7. Hub lock

1. Open top cover of drive. Face the drive and turn the supply reel so that the reel seat tab is in the 10 o'clock position. Look through the hole in the top plate next to the supply reel at about 8 o'clock. Enter test 132. Does the hub lock move?

Yes - Continue at step 2.

No - Continue at step 3.

2. While the door lock is pulled in (Display shows "UNLOCKED"), turn the supply hub slowly by hand counterclockwise. Does the hub stop with the reel seat tab at about the 9 o'clock position?

Yes - PASS.

No - Remove the supply hub and repair or replace the hub or bellcrank as necessary.

3. Check (Harness). Is the connection ok?
Yes - Continue at step 4.
4. Check power to the hublock on Sensor/Servo board at CR39 cathode for PWB Set A, CR58 cathode for PWB Set B, or CR27 cathode for PWB Set C. Does the voltage toggle between -15 and +10 volts?
Yes - Replace the hublock.
No - Replace the Sensor/Servo board.

4.4.8. NOVRAM offset

1. From Unload state. Measure voltage across Supply and Takeup motors on the Sensor/Servo board at TP-7 and 8 for PWB Set A, TP 34 and 35 for PWB Set B, and TP-37 and 38 for PWB Set C for the supply; TP-6 and 9 for PWB Set A, TP 32 and 33 for PWB Set B, and TP-35 and 36 for PWB Set C for the takeup. Are both measurements less than 50 millivolts?
Yes - PASS.
No - Adjust offset using procedure 5.34.4.

4.4.9. Power supply

1. Is this a TUV machine?
Yes - Continue at step 2.
No - Continue at step 3.
2. On the Sensor/Servo board is the +37 volts measured at TP-5 on PWB Set A, the positive side of C4 on PWB Set B or the positive side of C6 on PWB Set C between +31.5 and +41 volts?
Yes - Continue at step 4.
No - Continue at step 9.
3. On the Sensor/Servo board is the +57 volts measured at TP-5 on PWB Set A, the positive side of C4 on PWB Set B, or the positive side of C6 on PWB Set C between +48.5 and +63 volts?
Yes - Continue at step 4.
No - Continue at step 9.
4. On the Sensor/Servo board at TP-42 for PWB Set A, the positive side of C258 for PWB Set B, or TP-13 for PWB Set C, is the +5 Vdc between +4.85 to +5.35 Vdc?
Yes - Continue at step 5.
No - Continue at step 13.
5. On the Sensor/Servo board at TP-37 for PWB set A, TP-2 for PWB Set B, or TP-4 for PWB Set C, is the +6 Vdc between +5.64 to +6.36 Vdc?

Yes - Continue at step 6.

No - Continue at step 13.

6. On the Sensor/Servo board at TP-38 for PWB Set A, TP-1 for PWB Set B, or TP-1 for PWB Set C, is the -6 Vdc between -6.36 to -5.64 Vdc?

Yes - Continue at step 7.

No - Continue at step 13.

7. On the Sensor/Servo board at TP-39 for PWB Set A, TP-4 for PWB Set B, or TP-3 for PWB Set C, is the +12 Vdc, between +11.28 to +12.72 Vdc?

Yes - Continue at step 5.

No - Continue at step 13.

8. On the Sensor/Servo board at TP-40 for PWB Set A, TP-3 for PWB Set B, or TP-2 for PWB Set C, is the -12 Vdc between -12.72 to -11.28 Vdc?

Yes - PASS.

No - Continue at step 13.

9. Check the (Harness) where it plugs into the power supply.

10. Is the power cord ok?

Yes - Continue at step 11.

No - Replace power cord

11. Is the fuse at the rear of the drive ok?

Yes - Continue at step 12.

No - Replace fuse

12. Is the power switch ok?

Yes - Replace power supply

No - Replace power switch

13. Replace the Sensor/Servo board. Is the voltage ok now?

Yes - PASS.

No - Turn off the power and reinstall the original Sensor/Servo board. Pull out the other boards one at a time until voltage is ok. Replace the board that was causing the problem.

4.4.10. Supply motor

1. With power off, turn supply motor by hand. Does motor turn in both directions smoothly?

- Yes - Continue at step 2.
No - Replace supply motor.
2. Enter test 111. Before selecting a test mode, does the motor spin?
- Yes - Continue at step 6.
No - continue at step 3.
3. Select the manual supply mode in test 111. Run the supply motor up to approximately 50 counts. Does the motor move?
- Yes - Continue at step 8.
No - Continue at step 4.
4. Check the (Harness). Is it ok?
- Yes - Continue at step 5.
5. Is the drive on the Sensor/Servo board ok?
- Yes - Replace motor.
No - Replace Sensor/Servo board.
6. Is the motor spinning fast or slow?
- Fast - Continue at step 10.
Slow - Continue at step 7.
7. Check (NOVRAM) offsets. Are they ok?
- Yes - Replace Sensor/Servo board.
No - Adjust the offset using procedure 5.34.4.
8. Is the speed of the motor fairly constant?
- Yes - Continue at step 9.
No - Replace Sensor/Servo board.
9. Reverse direction of the motor. Is the speed about the same as in the opposite direction?
- Yes - PASS.
No - Continue at step 7.
10. Replace Sensor/Servo board. Does motor still spin fast?
- Yes - Reinstall first servo board and continue at step 7.
No - PASS.

4.4.11. Tach assembly

1. Enter 111 auto oscillate mode. Are both tach phases on the Sensor/Servo board ok? (Use O-scope and read at U11L pin 13 and pin 14 for PWB Set A, U16H pins 13 and 14 for PWB Set B, or U12J pins 2 and 13 for PWB Set C.)

Yes - PASS.

No - Continue at step 2.

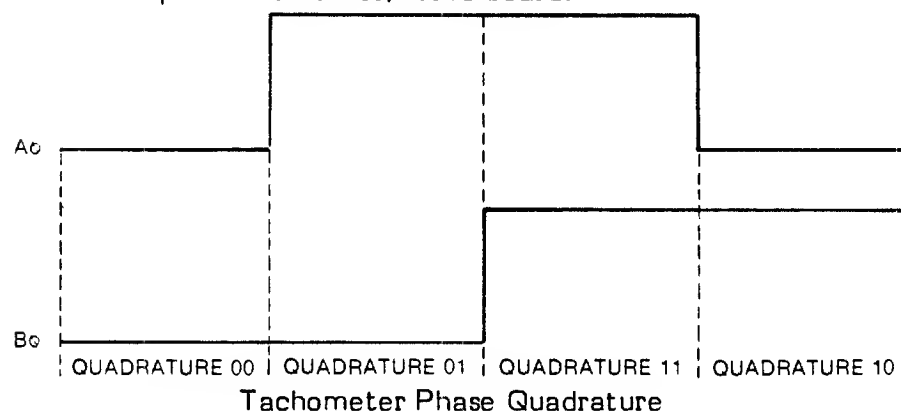
2. Check (Harness). Is it ok?

Yes - Continue at step 3.

3. Is the power from the Sensor/Servo board to the tach ok?

Yes - Replace the tach assembly.

No - Replace the Sensor/Servo board.



4.4.12. Takeup motor

1. With power off, turn takeup motor by hand. Does motor turn in both directions smoothly?

Yes - Continue at step 2.

No - Replace takeup motor.

2. Enter test 111. Before selecting a test mode, does the motor spin?

Yes - Continue at step 6.

No - continue at step 3.

3. Select the "MAN TAKE-UP" mode in test 111. Run the takeup motor up to approximately 50 counts. Does the motor move?

Yes - Continue at step 8.

No - Continue at step 4.

4. Check the (Harness). Is it ok?
Yes - Continue at step 5.
5. Is the drive on the Sensor/Servo board ok?
Yes - Replace motor.
No - Replace Sensor/Servo board.
6. Is the motor spinning fast or slow?
Fast - Continue at step 10.
Slow - Continue at step 7.
7. Check (NOVRAM) offsets. Are they ok?
Yes - Replace Sensor/Servo board.
No - Adjust the offset using procedure 5.34.4.
8. Is the speed of the motor fairly constant?
Yes - Continue at step 9.
No- Replace Sensor/Servo board.
9. Reverse direction of the motor. Is the speed about the same as in the opposite direction?
Yes - PASS.
No - Continue at step 7.
10. Replace Sensor/Servo board. Does motor still spin fast?
Yes - Reinstall first servo board and continue at step 7.
No - PASS.

4.4.13. Tape in path

1. Enter test 131. Place your hand between the tape in path transmitter and receiver. Does the "T" in the display come on?
Yes - PASS.
No - Continue at step 2.
2. Is the (Harness) ok?
Yes - Continue at step 3.

3. On the Sensor/Servo board, check R118 for PWB Set A, R270 for PWB Set B, or R149 for PWB Set C for power to the tape-in-path transmitter and receiver. Is the voltage between 4.85 to 5.35 Vdc?

Yes - Replace the transmitter, if that does not fix the problem, replace the receiver.

No - Replace the Sensor/Servo board.

4.4.14. Common data problems

1. Check (Read threshold).
2. Check head cables.
3. Clean head, tape scraper, and roller guides.
4. Check the NOVRAM configuration with the values that were recorded before the drive started having problems. Pay special attention to the Parity, ramp delay, and transfer rate.

4.4.15. Read threshold

1. Enter test 212. Measure and record read after write envelope on the Data board at TP-60, TP-62, and TP-64 on PWB Set A; TP-93, TP-96, and TP-99 on PWB Sets B and C. Read the value from the zero point to the positive peak of the wave form. Average these three readings together for the other calculations. Measure and record Vcom at U15U pin 7 on PWB Set A and U26U pin 7 on PWB Sets B and C. This is Vcom1. Rewind and exit test. Measure and record Vcom once more. This is Vcom2. Is the average of the read after write envelope readings between the min and max values for Vcom1 in the read threshold table at the end of this test? (If the value you get isn't in the table, the average read after write envelope times 30% should be equal to Vcom1 plus or minus 5%.)

Yes - Continue at step 2.

No - Run (test 513) to set read threshold.

2. Is the average of the readings between the min and max values for Vcom2 in the read threshold table at the end of this test? (If the value you get isn't in the table, the average read after write envelope times 15% should be equal to Vcom1 plus or minus 3%.)

Yes - PASS.

No - Run (test 513) to set read threshold.

Read Threshold Table

Peak Average	VCOM1		VCOM2	
	min	max	min	max
0.500	0.133	0.147	0.049	0.052
0.600	0.160	0.176	0.058	0.062
0.700	0.186	0.206	0.068	0.072
0.800	0.213	0.235	0.078	0.082
0.900	0.239	0.265	0.087	0.093
1.000	0.266	0.294	0.097	0.103
1.100	0.293	0.323	0.107	0.113
1.200	0.319	0.353	0.116	0.124
1.300	0.346	0.382	0.126	0.134
1.400	0.372	0.412	0.136	0.144
1.500	0.399	0.441	0.146	0.155
1.600	0.426	0.470	0.155	0.165
1.700	0.452	0.500	0.165	0.175
1.800	0.479	0.529	0.175	0.185
1.900	0.505	0.559	0.184	0.196
2.000	0.532	0.588	0.194	0.206

4.4.16. Set Internal/Field Mode (Test 542)

CAUTION: Care must be taken when using 500 series tests. Follow instruction to the letter. Failure to do so could render the GCR unit inoperable.

(Internal Mode)

1. Enter test 542, does display scroll "SET FIELD MODE? YES NO".
 Yes - Press the UNLOAD switch, then the DENSITY SELECT switch to exit the test.
 No - Continue to step 2.
2. "PASSWORD ?" is displayed, enter 54524. Display now reads "MODE ?", press the LOAD switch and now "INTERNAL" is displayed, press DENSITY SELECT switch to exit the test.

You are now in the internal mode and can run test 513.

(Field Mode)

1. Enter test 542, does display show "SET FIELD MODE? YES NO".
 Yes - Press LOAD switch and "YES" is now displayed. Press DENSITY SELECT to exit the test.
 No - "PASSWORD" is displayed. Press the WRT EN/TEST switch to cancel the test.

4.4.17.A Automatic Write Current Calibration (-006 and lower firmware)

1. This test requires that a write enabled tape be loaded before entering.
2. Enter test 513 per instructions in 4.4.16.
3. Test will now run automatically. When test is done the display will either read "PASS" or "FAIL". Did the test pass?

Yes - PASS Go to step 4.

No - FAIL, Check the last component that was installed prior to running this test. Check all contacts and connections and the backplane.

4. Return the tape drive back to Field Mode (test 542).

4.4.17.B Write Current Calibration (-007 and higher firmware)

1. Connect a jumper between U1H Pin 1 and ground on the Data PWB.
2. Power up the tape drive, enter test 142, and record for later use the values of options 22 through 27.
3. Exit test 142.
4. Enter test 542.

CAUTION: Care must be taken when using 500-series tests. Follow instructions exactly. Failure to do so could render the tape drive inoperable.

Is "SET FIELD MODE? YES NO" displayed?

Yes - Press the UNLOAD switch; "NO" is displayed. Press the DENSITY SELECT switch; the UNLOAD LED goes on. Go to Step 6.

NO - Go to Step 5.

5. "PASS WD?" is displayed. Enter 54524; "MODE?" is displayed. Press the LOAD switch; "INTERNAL" is displayed. Press the DENSITY SELECT switch; the UNLOAD LED goes on. Go to Step 6.
6. Load a good quality 10.5-inch reel of write-enabled tape, preferably a Standard Output Tape. Data will be written to the tape.
7. Enter test 513. "HEAD CAL" is displayed for several seconds, then "READY" or "-60 MV" is displayed. If "-60 MV" is displayed, go to step 8. If "READY" is displayed, go to step 9.
8. (The +5V supply is low or the -12V supply is high; the VCOM line may have a negative offset that cannot be adjusted automatically by the tape drive.) The LOAD, UNLOAD, and ONLINE LEDs are on; the WRT EN/TEST LED is flashing.

Connect a digital volt meter to the VCOM line at pin 7 of any read amplifier chip. Set the offset to -60 ± 1.2 millivolts using the front panel switches as follows:

LOAD Adds 2.2 millivolts of positive offset with each actuation. No more than +60 millivolts can be added. If the maximum offset is added without reaching -60 ± 1.2 millivolts, exit test 513 (press UNLOAD) and start troubleshooting with the Sense/Servo PWB.

UNLOAD Aborts test 513 and unloads tape. NOVRAM data is not changed.

ONLINE Same as LOAD except that a negative 2.2 millivolts is added per actuation.

WRT EN TEST Exits this adjustment and continues at Step 9.

NOTE: If a digital volt meter is not available, press the LOAD switch twice to partially compensate for the negative offset. Press the WRT EN/TEST switch to continue to Step 9.

9. The UNLOAD and WRT EN/TEST LEDs are flashing. At this point you have the option of exiting test 513. Press the UNLOAD switch to exit the test and unload tape. Press the WRT EN/TEST switch to continue.
10. Values for the three operating densities will be entered during this step. They are found in one of two places: 1) At the top of the read/write head a tag has the values for 6250 and 3200 bpi; the lower value is the 6250 bpi current, the higher value is the 3200 bpi current. The 1600 bpi current is 4100. 2) If the tag is not there, use the NOVRAM values recorded in Step 2, options 22 (6250 bpi), and 24 (3200 bpi).

The LOAD, UNLOAD, and DENSITY SELECT LEDs are on. The density display reads "6250 BPI" and the alphanumeric display shows tens of microamperes (e.g., 1567 equals 15.67 milliamps). Enter the appropriate values for each density using the front panel switches as follows:

LOAD The first actuation starts tape motion, and an all ones pattern is written to tape at the displayed density. Successive actuations increase the current value in increments of 25 on the display (equals 0.25 milliamps). Pressing the ADRS SELECT switch while actuating the LOAD switch reduces the increments to 1 on the display (0.01 milliamps). In 6250 bpi density, the drive writes to all nine tracks; in 1600 and 3200 bpi, it writes to the six file mark tracks.

UNLOAD Same as LOAD, except that current value is decreased. The ADRS SELECT switch reduces decreases to 1 on the display.

ONLINE Stops tape motion.

WRT EN Exits this step and continues at Step 11. This switch does not
TEST function until all densities have been set and tape motion
 stopped; the WRT EN/TEST LED then flashes.

DENSITY Selects each density for editing or reviewing. Tape motion
SELECT must be stopped.

11. This step runs automatically. The tape drive determines the correct read threshold for each density based on the values entered during Step 10 and writes to tape in each density. When this step is completed, "THR DONE" is displayed, the LOAD, ONLINE, and DENSITY SELECT LEDs are on, and WRT EN/TEST is flashing.

12. The average peak-read amplitude (EOUT) and read-after-write (RAW) voltages can now be examined or this step may be skipped by pressing the WRT EN/TEST switch. The front panel switches function as follows:

LOAD The first actuation causes "EOUT AVG" then the value of the
 selected density in millivolts to be displayed. The second
 actuation causes "THRESHLD" then the value of the new
 RAW voltage to be displayed. Used in conjunction with the
 DENSITY SELECT switch.

ONLINE Aborts the display sequence started by pressing the LOAD
 switch. (The LOAD switch may be pressed again.)

WRT EN Exits this step and continues at Step 13.
TEST

DENSITY Changes the density of the EOUT and RAW voltages being
SELECT displayed. Used in conjunction with the LOAD switch.

13. "SAVE NEW" is displayed and the LOAD and UNLOAD LEDs are flashing. This step allows the new values to be written to NOVRAM or the existing values to be retained. The front panel switches function as follows:

LOAD A 'yes' response. New values are written to NOVRAM.

UNLOAD A 'no' response. New values are discarded and the existing
 values remain in NOVRAM.

After a yes or no response is entered, "NEW DATA" or "OLD DATA", respectively, is displayed for several seconds.

NOTE: If you use tests 142 or 242 to verify values just entered, the values may differ slightly because of binary to decimal translation. Readings that vary by up to 20 counts are acceptable.

14. Enter test 542. "SET FIELD MODE? YES NO?" is displayed. Press the LOAD switch, then the DENSITY SELECT switch.

15. Unload the tape. Switch the drive power off.

16. Remove the jumper from the Data PWB.
17. Remove the safety pin from the support arm. Lower the drive to the operating position. Secure the chassis retaining screws.

Chapter 5. Preventive Maintenance and Replacement Procedures

5.1 Preventive Maintenance Schedule

Instructions for performing the maintenance listed in the table below are in **section 6.3**.

Part	Frequency (hours)
Tachometer Roller	40*
Hub pads	40*
Take Up Hub	40*
Roller Guides	40*
Sensors	40*
Head	20*
Tape Cleaner	40*
Filter	Quarterly

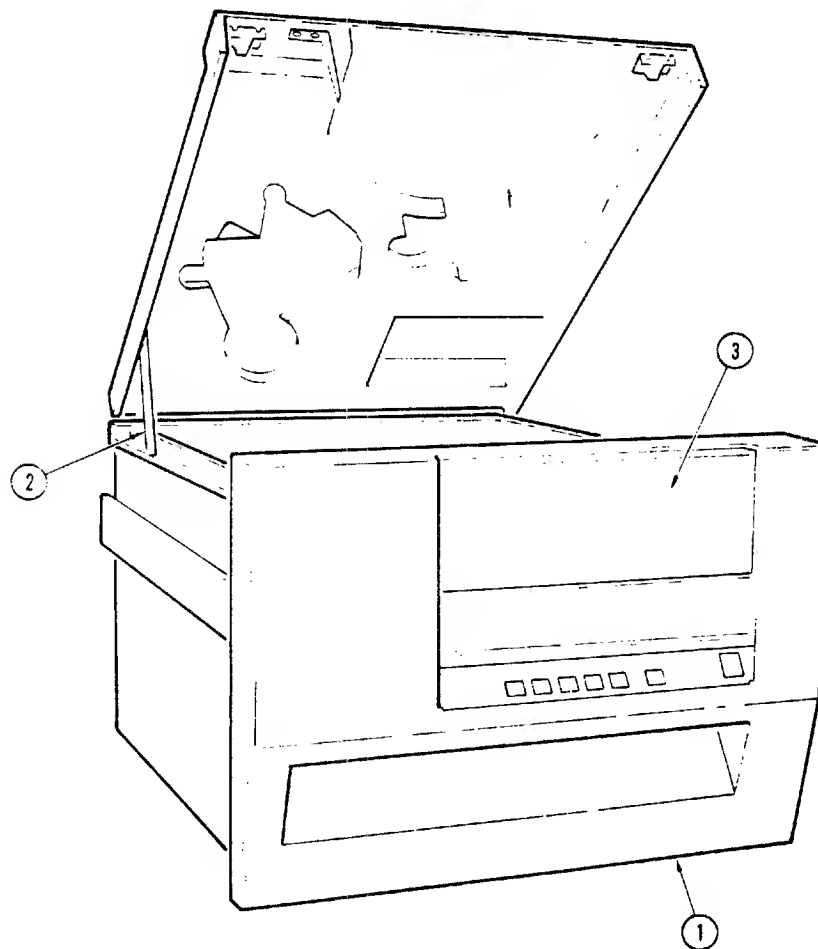
- * The schedule should be performed weekly if enough hours are not accumulated in a typical week.

5.2 Placing Unit In Operator Access Position

1. Switch off ac power.

CAUTION: If the tape unit is to be extended on its slides from the equipment rack for maintenance, ensure that the rack is stabilized. Weight of the transport in the extended position could upset an inadequately mounted equipment rack.

2. Pull the tape unit out of the rack by using the front panel at position (1).
3. Withdraw the drive on its slides. Make sure the tape unit is clear of the unit above before you open the top cover.
4. Open the top cover and support it with the stay arm (2).
5. Open the operator access cover (3).



5.3 Placing Unit In Service Position

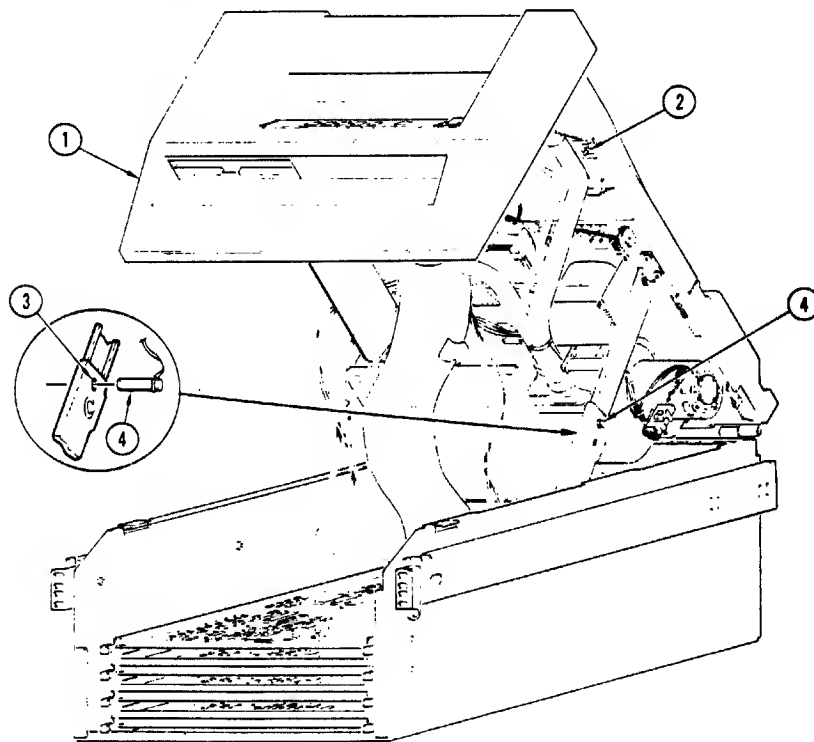
6. Switch off ac power.

CAUTION: Before extending the drive on its slides from the equipment rack for maintenance, ensure that the rack is stabilized. Weight of the transport in the extended position could upset an inadequately mounted equipment rack.

7. Pull the tape unit out of the rack by using the front panel at position (1).
8. While holding the front panel firmly, withdraw the drive on its slides until the slide locks engage. Make sure the tape unit is clear of the unit above before opening the top cover.
9. Open the top cover and secure it with the stay arm provided.
10. Loosen the two spring-loaded screws (2) on both sides of the base plate.
11. Close the top cover.
12. Lift up on the two lower corners of the front panel to its maximum position. The latch mechanism locks in an upright position. Install the locking pin (4) provided.

WARNING

Insert the provided locking pin (4) into the hole (3) in the tape unit support arm. Never service the tape unit in the service position unless you install the locking pin. See Illustration.



5.4 Restoring Unit To Operating Position

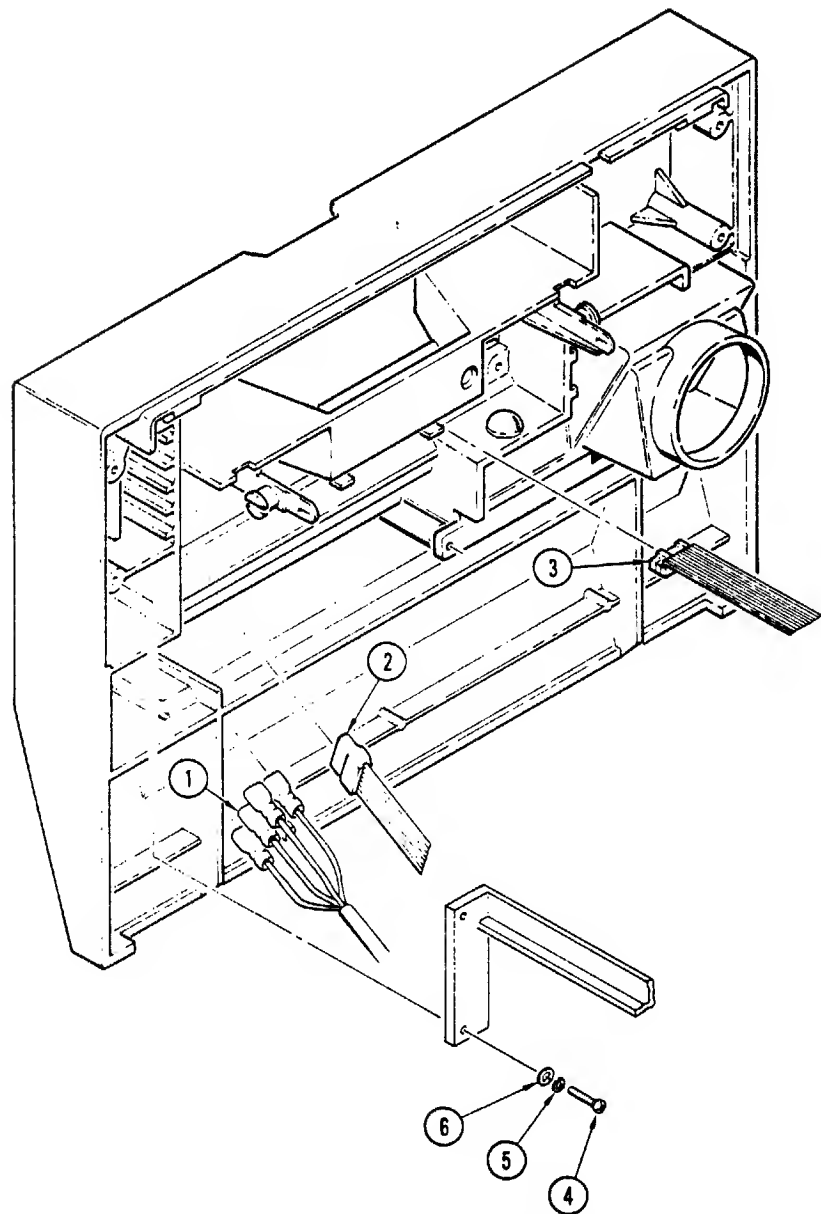
1. Switch off ac power.
2. Remove the lock pin (4), and pull up on the tape unit to release the latch mechanism.
3. While lowering the drive, make sure that the cables are secure and are not pinched.
4. Open the top cover and secure it with the stay arm provided.
5. Secure the spring-loaded screws (2) to lock the base unit to the frame.
6. Close the top cover.
7. Press in on the locking tabs in the slides and push the tape unit into the rack until secure.

5.5 Front Panel

5.5.1 Removal

1. Switch off ac power.
2. Disconnect the ac power cord.
3. Place the unit in the service position.
4. Note the wire positions and disconnect the ac power switch cable (1) from the ac power switch.
5. Disconnect the cable connector (2) from the switch-LED front panel.
6. Disconnect the cable connector (3) from the alphanumeric display.
7. Remove the four screws (4), flat washers (5), and lockwashers (6).

8. Lift the front panel from the unit. Note the position of the air ducts for replacement.



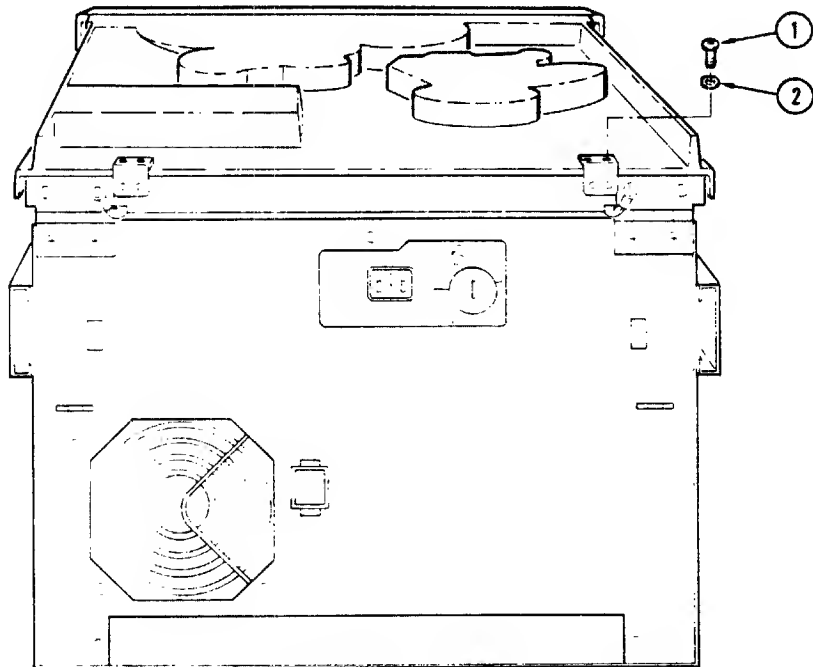
5.5.2 Replacement

To replace the front cover, reverse the removal procedure steps. Also, be sure to replace all air ducts.

5.6 Top Cover

5.6.1 Removal

1. Switch off ac power.
2. Place the unit in the operator access position. (See section 5.1.)
3. Remove the four screws (1), and four washers (2) to remove the cover.



5.6.2 Replacement

To replace the top cover, reverse the removal procedure steps. Proceed to the adjustment procedure.

5.6.3 Adjustment

1. Adjust the rear hinges so that the top cover opens and closes without binding on the front cover.
2. Adjust the ball latches on the top cover to ensure that the top cover is fully closed.

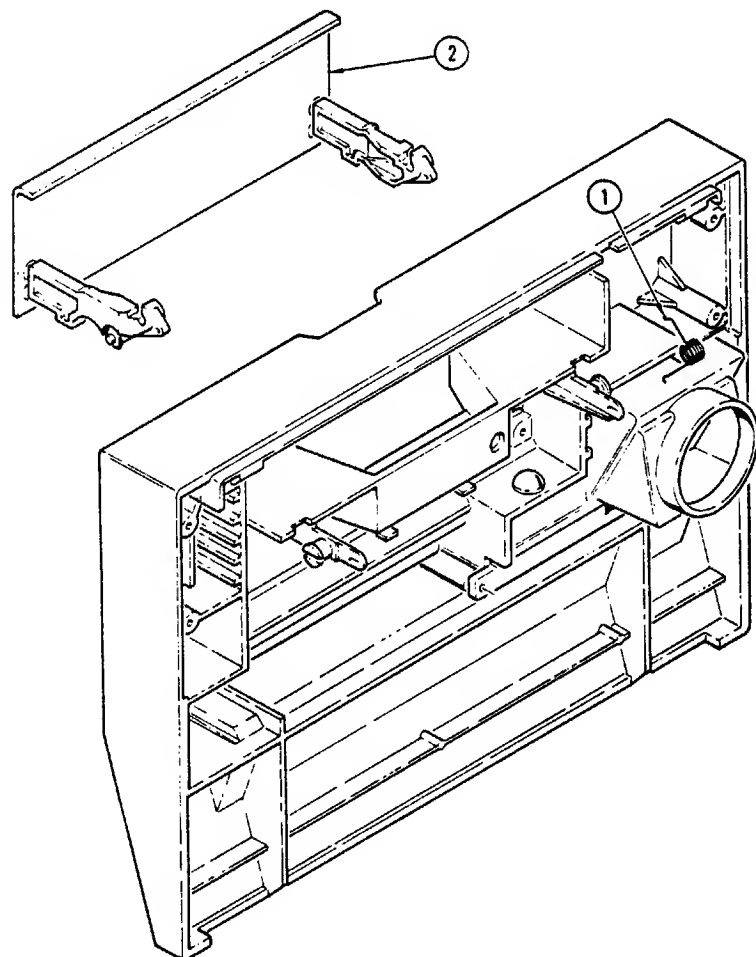
5.7 Operator Access Cover

5.7.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the front panel. (See section 5.5.)
4. Remove the two springs (1).

Note: The springs are under compression. Take care when removing them.

5. Push out the operator access cover (2) from the rear of the front cover.



5.7.2 Replacement

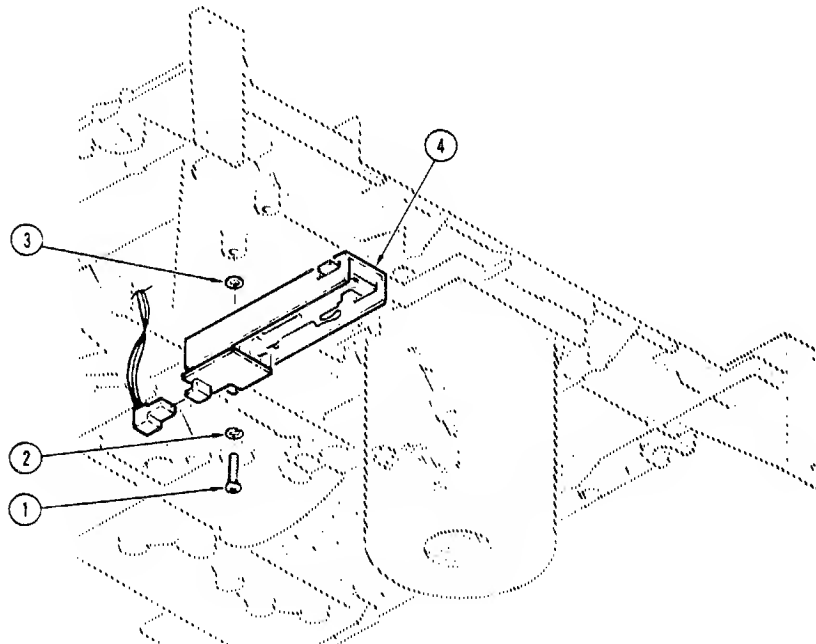
To install the operator access cover, reverse the removal procedures. Ensure that the bearing surface of each arm has a small amount of Lubriplate on it.

1. Open and close the operator access cover.
2. Make sure that the access cover returns to the fully closed position.
3. If the access cover does not close properly, adjust the two springs (2) and repeat until the cover closes properly.

5.8 Cover Lock Assembly

5.8.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.3.)
3. Remove the front panel.
4. Remove the main air duct. (See section 2.2.)
5. Locate the cover lock assembly (4) next to the air duct.
6. Remove the two screws (1), two lock washers (2), and two washers (3) from the cover lock assembly.
7. Remove the connector from the lock assembly.



5.8.2 Replacement

1. Install the assembly and reverse the removal procedure.
2. Perform the adjustment procedure, 5.8.4.

5.8.3 Service Check

1. Enable test 132 with both of the covers closed. (See section 4.1.3 for diagnostic tests.)
2. When both of the covers and the cover lock assembly are properly adjusted, the On-line LED should be off. If not, perform the adjustment procedure 5.8.4.

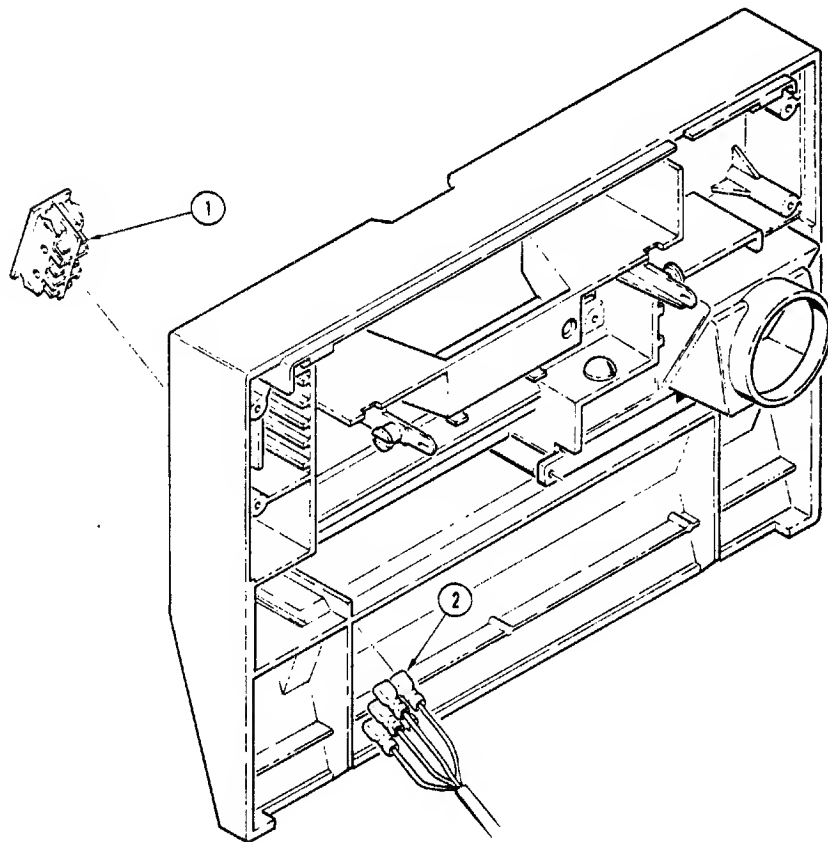
5.8.4 Adjustment

1. Close the top cover of the tape unit.
2. Attempt to close the operator access cover with light pressure. If the access cover does not close completely, loosen the screws, and push the cover lock assembly toward the front of the unit until the access cover closes.
3. Switch on ac power and press the Load switch. If the LOADING message is displayed, cover lock assembly is properly positioned. If the NO DOOR LOCK message is displayed, loosen the screws, and push the cover lock assembly slightly forward toward the front of the tape unit.
4. Repeat step 3 until the Loading LED is flashing.
5. Restore the unit to an operating position. (See section 5.2.)

5.9 AC Power Switch

5.9.1 Removal

1. Switch off ac power.
2. Disconnect the ac power cord.
3. Place the unit in the service position. (See section 5.2.)
4. Disconnect the ac power switch cable (2) from the switch. Note the position of the wires for replacement.
5. Bend the tabs (1) that hold the switch to the panel, and push the switch out from the back.



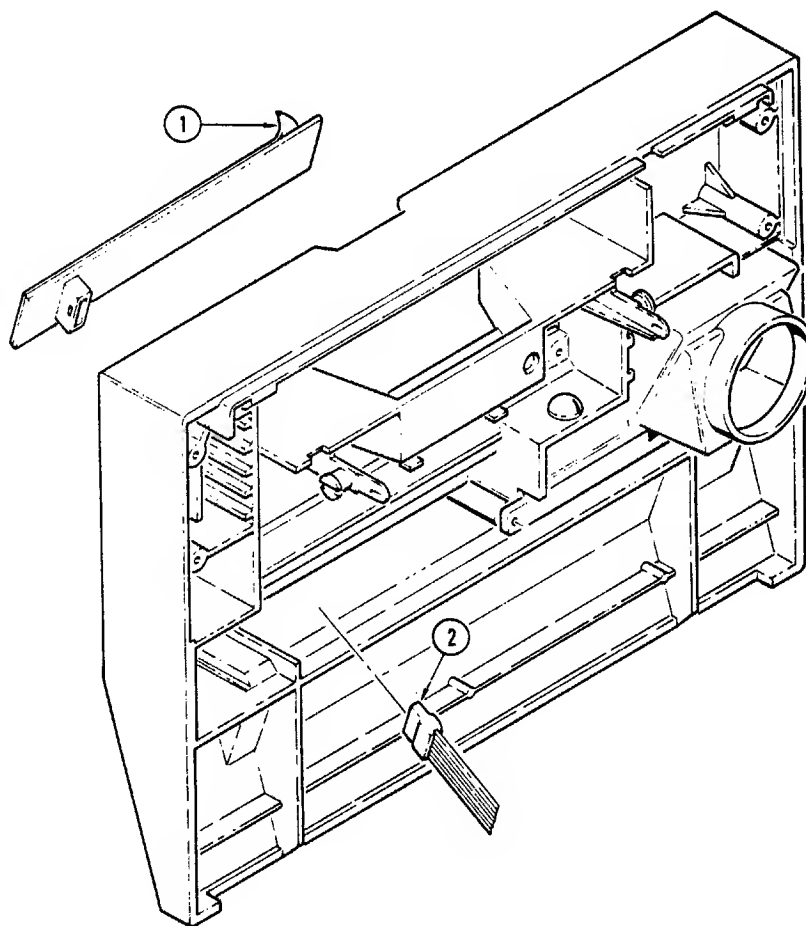
5.9.2 Replacement

1. Install the switch.
2. Bend the tabs in back of the switch as necessary for a proper fit.
3. Reinstall ac cable (2) to the switch terminals.

5.10 Switch-LED Front Panel

5.10.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the connector (3) from the switch panel back.
4. Remove the front cover. (See section 5.5.)
5. Remove the switch-LED panel (1) from the front cover by peeling off from the front.



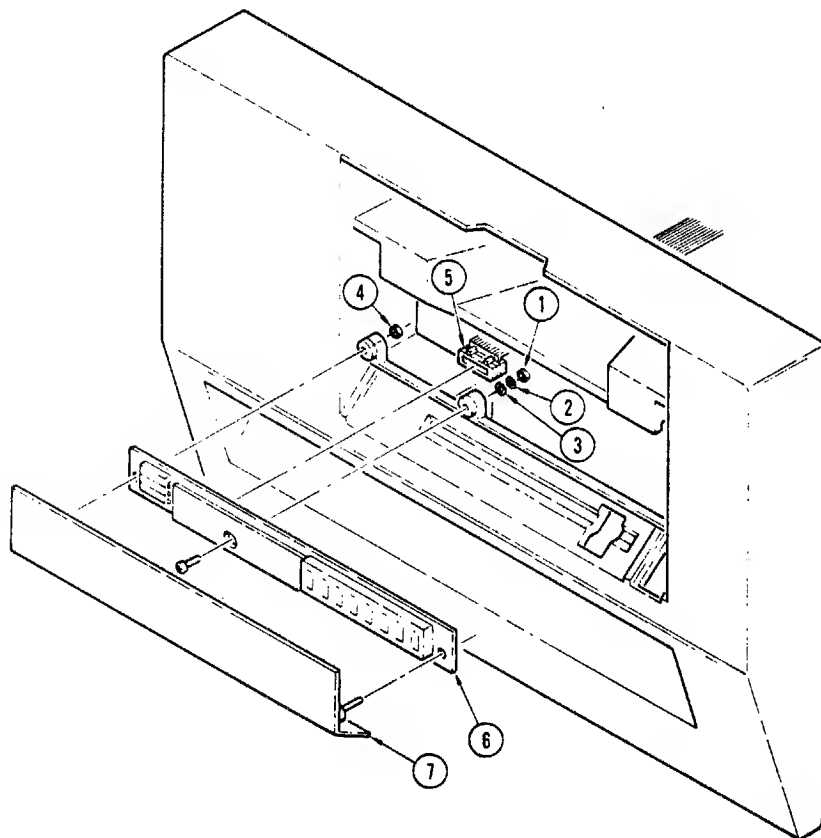
5.10.2 Replacement

Install the panel, and reverse the removal procedure.

5.11 Alphanumeric Display

5.11.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove connector (5) from back of display PWB.
4. Remove nut (1), lockwasher (2), and flatwasher (3).
5. Remove push-on retaining rings (4).
6. Remove cover (7) and diagnostic PWB (6) from front panel.



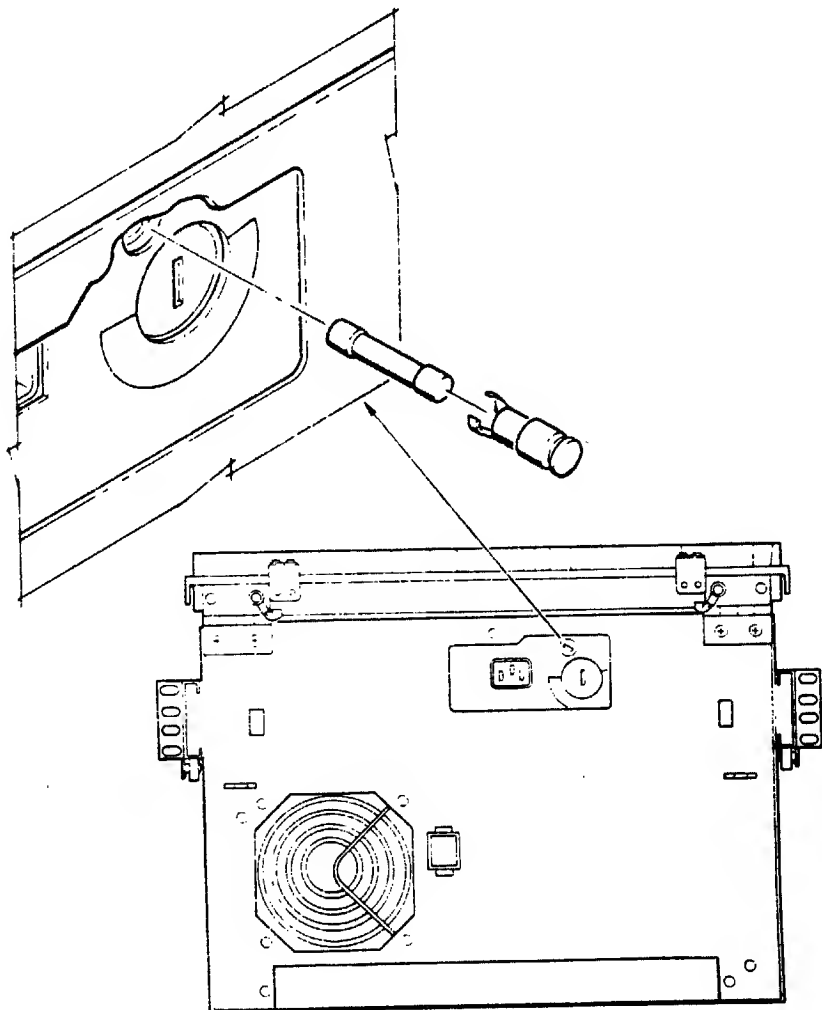
5.11.2 Replacement

Install the diagnostic PWB, and reverse the removal procedure.

5.12 Fuse

5.12.1 Removal

1. Switch off ac power.
2. Disconnect the ac power cord.
3. Locate the fuse F1 on the power supply enclosure through the rear of the chassis and remove it.
4. For 100-120V range, use a 6.25A slow-blow fuse for drives with 57V Servo PWBs or a 4A slow-blow for 37V PWBs.
5. For 200-240V range, use a 3A slow-blow fuse for drives with 57V Servo PWBs or a 2A slow-blow fuse for 37V PWBs.



5.12.2 Replacement

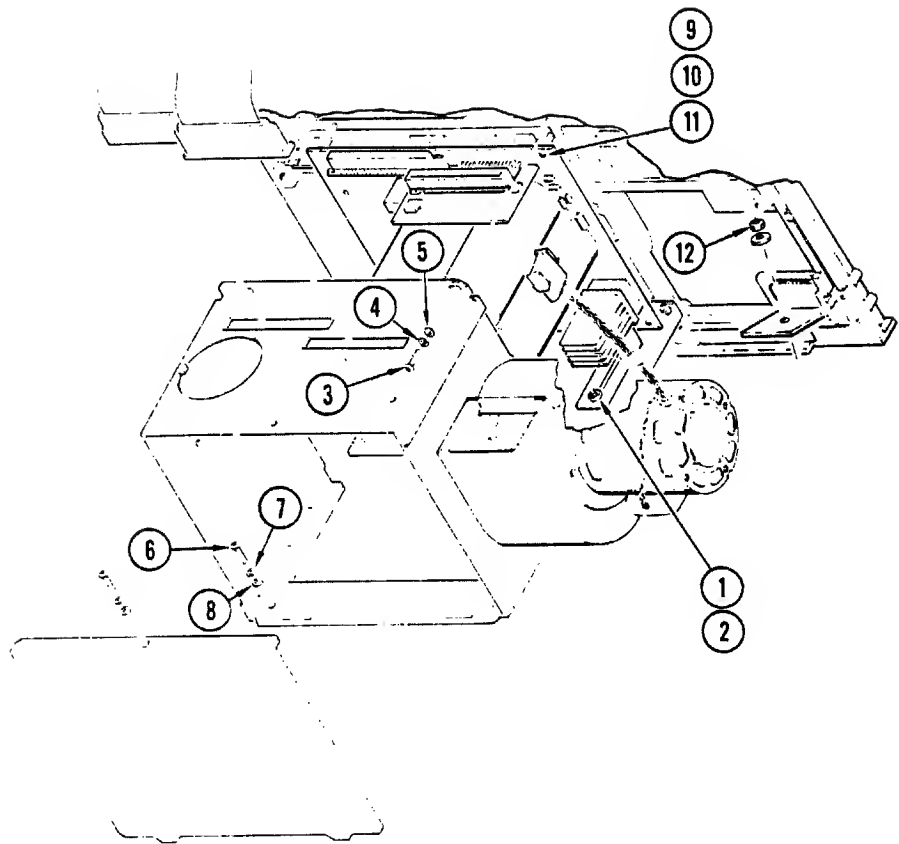
To replace the fuse, reverse the removal procedure steps.

5.13 Power Supply Enclosure and PWB

5.13.1 Removal

Switch off ac power and disconnect the ac power cord.

1. Switch off ac power and disconnect the ac power cord.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the four tape unit boards from the PWB rack. (See sections 5.34 through 5.37.)
4. Remove the front panel. (See section 5.5.) Remove the main and smaller air duct
5. Cut the cable ties holding the cables to the left side and front of the enclosure. Disconnect the connectors to the front of the enclosures.
6. Remove the screw attaching the ground wire to the side of the air pump assembly. Cut the cable tie around the air pump connector and disconnect the air pump from the wiring harness.
7. Remove nut (12) which secures Blower Motor to top plate.
8. Remove the power supply cover.
9. Remove the nut (1) and flatwasher (2) holding AC line filter bracket to the enclosure.
10. Remove the two socket head screws (3), two lockwashers (4), and two flatwashers (5) from the rear of the enclosure.
11. Remove the two screws (6), two lockwashers (7), and two flatwashers (8) from the front of the enclosure.
12. Disconnect the connector from the take-up motor to the power supply PWB.
13. Remove the four screws (9), lockwashers (10), and flatwashers (11) securing the power supply PWB.
14. Carefully lower the power supply enclosure and PWB from the top plate.
15. Remove the power supply PWB from the enclosure.



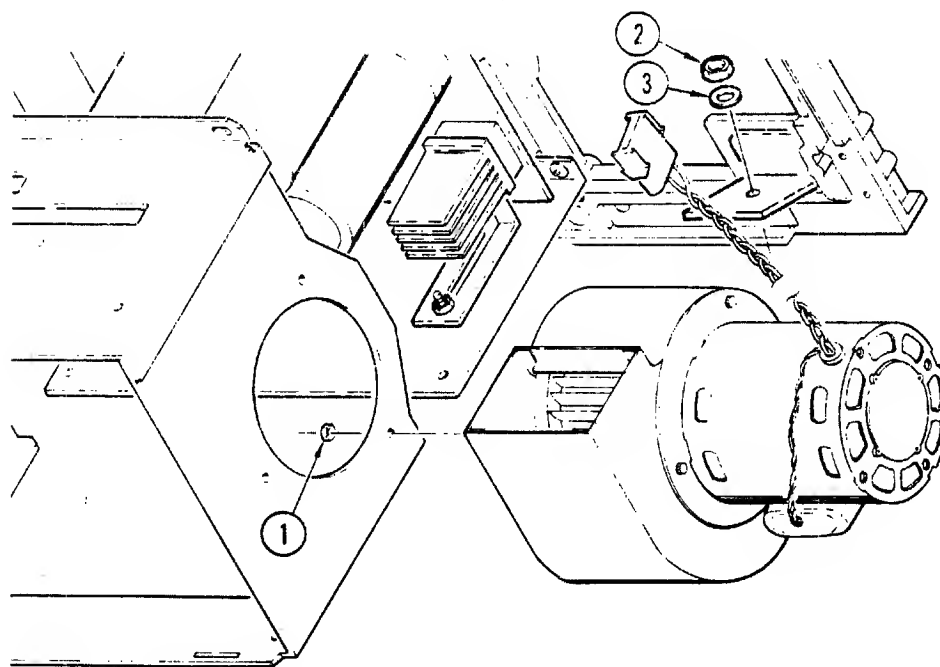
5.13.2 Replacement

1. To replace the power supply enclosure, reverse the removal procedure steps. Make sure not to pinch any cables when replacing the enclosure.
2. Use replacement cable ties to replace the cables.

5.14 Blower Motor

5.14.1 Removal

1. Switch off ac power.
2. Disconnect the ac power cord.
3. Place the unit in the service position. (See section 5.2.)
4. Note that a ground wire is attached to the power supply cover and remove the power supply cover.
5. Remove the cable ties on the power supply enclosure and remove the power supply enclosure. (See section 5.13.)
6. Remove the three nuts (1) that attach the blower motor to the power supply enclosure.
7. Remove the nut (2) and washer (3) securing the blower motor to its bracket.



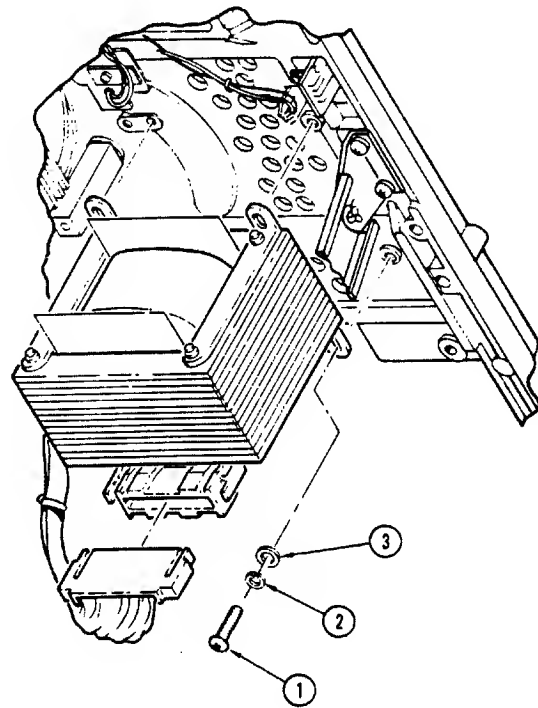
5.14.2 Replacement

Replace the blower motor by reversing the removal procedure.

5.15 AC Transformer

5.15.1 Removal

1. Switch off ac power.
2. Disconnect the ac power cord.
3. Place the unit in the service position. (See section 5.2.)
4. Remove the front cover. (See section 5.5.)
5. Remove the air duct that is in front of the transformer.
6. Remove plug from the transformer.
7. Remove the four screws (1), four lockwashers (2), and four washers (3) from the base of the transformer. Note the position of the cable ties and remove them.



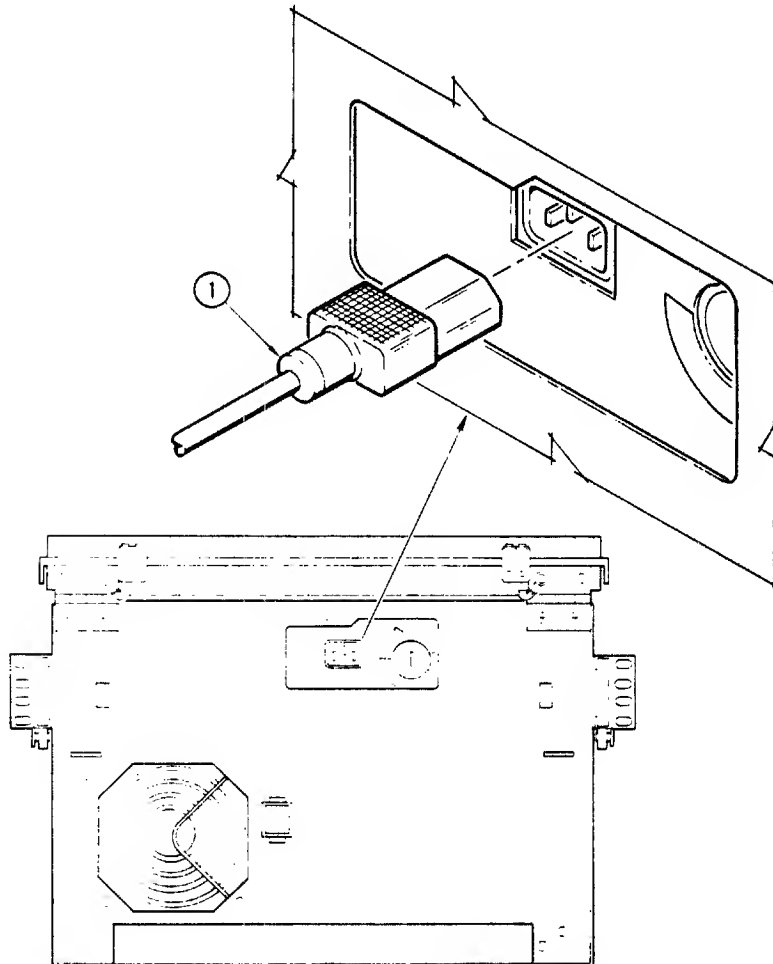
5.15.2 Replacement

Install transformer with the screws removed earlier. Reverse the removal steps for replacement.

5.16 AC Line Cord

5.16.1 Removal

1. Switch off ac power.
2. Disconnect the power cord from the ac socket.
3. Disconnect the ac power cord (1) from the back of the unit.



5.16.2 Replacement

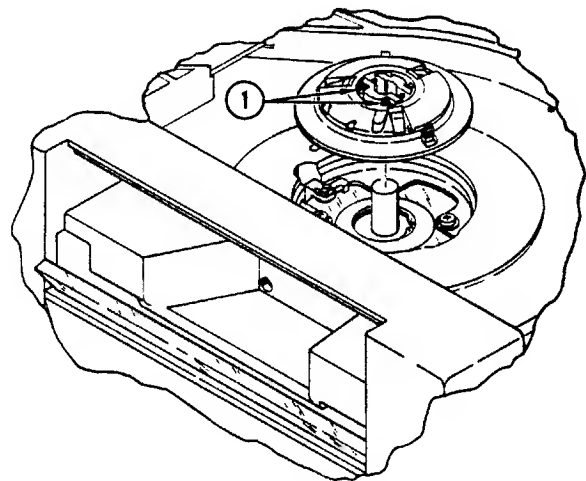
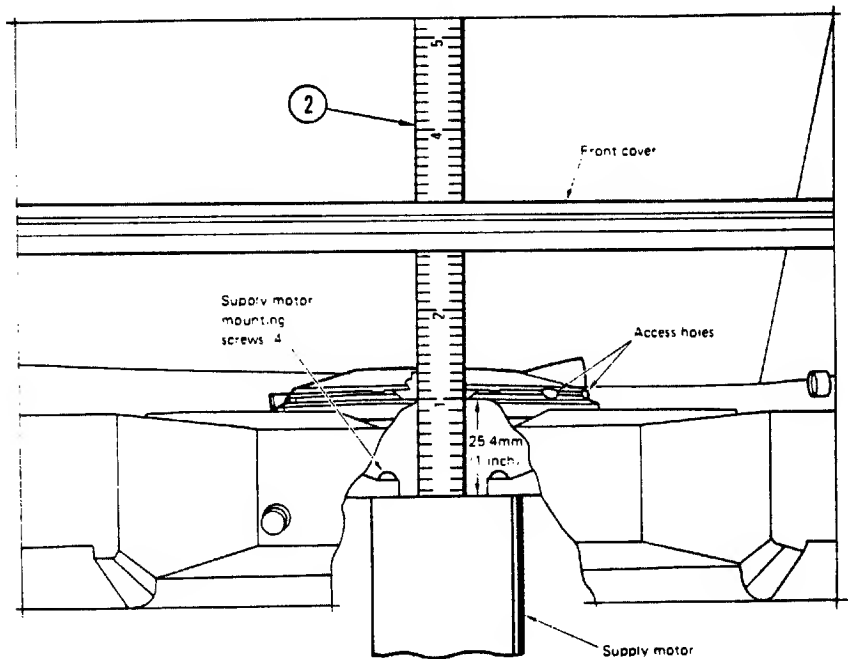
Reverse the removal procedure to replace ac line cord. Replace with the same type of cord and plug.

5.17 Supply Reel Hub

5.17.1 Removal

1. Switch off ac power.
2. Place the unit in the operator access position. (See section 5.1.)

3. Open the top cover and operator access cover.
4. Measure the hub height and record the value.
5. Rotate the supply hub until the clamp screws (1) are aligned with the front cover.
6. Locate the access holes in the hub and insert the wrench from the front of the machine to loosen the two screws (1).
7. Lift the hub off the motor shaft.



5.17.2 Replacement

Place the hub on the shaft. Do not tighten the screws. Proceed to the adjustment procedure.

5.17.3 Adjustment

1. With the reel hub pads down, insert the ruler scale (2) between the reel hub pad and the hub. Make sure the hub is in the position shown.
2. If only the supply hub was removed for repair or replacement, then use the hub height value recorded in the preceding removal steps and continue with step 4. If not, proceed to step 3.
3. Adjust the hub on the shaft until you obtain a gap of 25 mm (1 inch) between the motor case and edge of the hub. Tighten the screws (1).
4. Check the gap. If it is correct, proceed to step 5; if not, do step 3 until a proper gap is obtained.
5. Enable diagnostic test 131 to check the supply reel tab sensor. (See section 4.1 for diagnostic tests.) If the test is not correct, adjust the hub up or down for the proper LED results.
6. Load a tape and manually lock and unlock by running test 132, and check to see that the hub locks and unlocks properly.
7. Enable diagnostic test 212. At 100 ips, run the tape out to the EOT marker and start the test in the reverse direction. Observe the tape while it is rewinding onto the supply reel. If the tape is not centered on the hub, adjust the hub height as necessary.
8. Restore the unit to the operating position. (See section 5.3.)

5.18 Read/Write Head

5.18.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the read and write cables from the head assembly.
4. Remove Azimuth adjusting screw (4).
5. While supporting the read/write head with your hand, remove four screws (2), four lockwashers (3), four washers (4) and remove the head from the tape unit.

CAUTION: Use extreme care when removing and replacing the read/write head; do not allow ANYTHING to come in contact with the FACE of the HEAD.

2. Hold the head in place and tighten the four mounting screws within equal amount of torque. Verify wrap angle adjustment after tightening screws.
3. Section 5.19.3 and perform the Tape Scraper Adjustment.
4. Load a skew tape, Cipher Part No. 799019-401, **WITHOUT** a write enable ring.
5. Disable the front panel door and top cover interlock using test 133. Refer to section 4.1.3.
6. Press the Load/Rewind switch to load the tape.
7. Connect the oscilloscope to J1-19 on the Data Board.
8. Remove the center adjustment screws, and clean dried Vibratight.
9. Apply fresh Vibratight, Cipher Part No. 209990-075, to threads of adjustment screw and reinstall loosely into baseplate.
10. Use test 212 (section 4.1.4) in 1600 bpi mode to move tape forward at 100 ips.
11. Adjust azimuth screw so that outputs of all tracks fall within 12% or less of the byte-to-byte period. See Figure 5.18.3 Skew Adjustment Waveform.
12. Alternate tape direction between forward and reverse and optimize skew adjustment by minimizing the skew pulse width. Make final adjustment by optimizing forward skew (smallest skew pulse). Run forward to EOT and run reverse to BOT without stopping.
13. Apply torque seal, Cipher Part No. 209994-025 to head of adjustment screw. Run Test 513.
14. Unload the skew tape and refer to section 5.38 to check tape path alignment.
15. Perform Test 542 (section 4.4.16) and Test 513 (section 4.4.17).

5.19 Tape Scraper

5.19.1 Removal

1. Remove two socket-head screws (3), nuts (1), lockwashers (5), and flat washer (2).

5.19.2 Replacement

1. Install replacement scraper in reverse order of removal.

5.19.3 Adjustment

1. Insert and load a tape.
2. Loosen socket-head screws (3) and move tape scraper away from tape.

5. Disable the front panel door and top cover interlock using test 133. Refer to section 4.1.3.
6. Press the Load/Rewind switch to load the tape.
7. Connect the oscilloscope to J1-19 on the Data Board.
8. Remove the center adjustment screws, and clean dried Vibratight.
9. Apply fresh Vibratight, Cipher Part No. 209990-075, to threads of adjustment screw and reinstall loosely into baseplate.
10. Use test 212 (section 4.1.4) in 1600 bpi mode to move tape forward at 100 ips.
11. Adjust azimuth screw so that outputs of all tracks fall within 12% or less of the byte-to-byte period. See Figure 5.18.3 Skew Adjustment Waveform.
12. Alternate tape direction between forward and reverse and optimize skew adjustment by minimizing the skew pulse width. Make final adjustment by optimizing forward skew (smallest skew pulse). Run forward to EOT and run reverse to BOT without stopping.
13. Apply torque seal, Cipher Part No. 209994-025 to head of adjustment screw. Run Test 513.
14. Unload the skew tape and refer to section 5.38 to check tape path alignment.
15. Perform Test 542 (section 4.4.16) and Test 513 (section 4.4.17).

5.19 Tape Scraper

5.19.1 Removal

1. Remove two socket-head screws (3), nuts (1), lockwashers (5), and flat washer (2).

5.19.2 Replacement

1. Install replacement scraper in reverse order of removal.

5.19.3 Adjustment

1. Insert and load a tape.
2. Loosen socket-head screws (3) and move tape scraper away from tape.
3. Slowly move the tape scraper toward the tape until it just barely makes contact with the tape.
4. Rotate tape scraper until both scraper blades are touching the tape, producing two vertical creases in the tape at the points of contact.

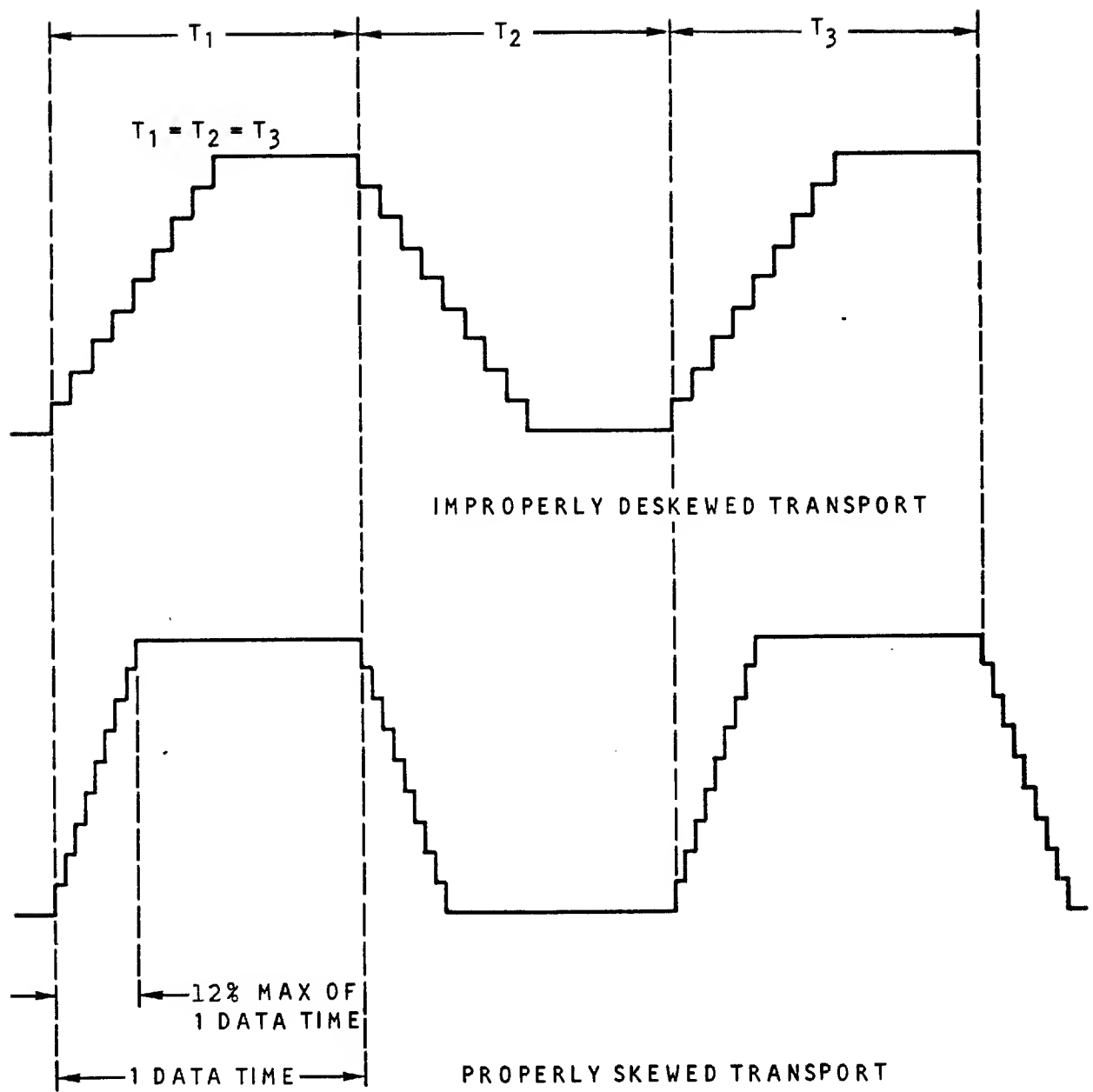
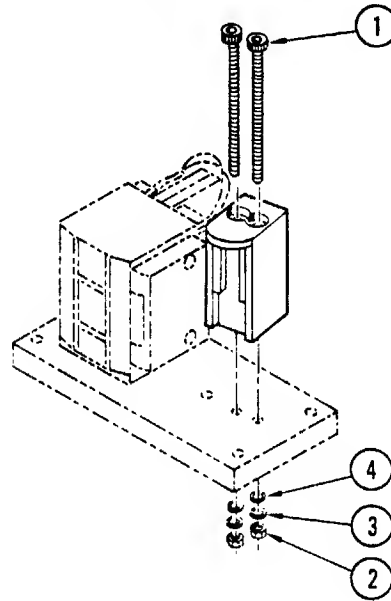


Figure 5.18.3 Skew Adjustment Waveform

5. Verify that tape is touching erase bar. Check for vertical crease in tape at the point of contact.
6. Tighten socket-head screws (3) and reverify that tape is in contact with both blades of tape scraper and the erase bar.



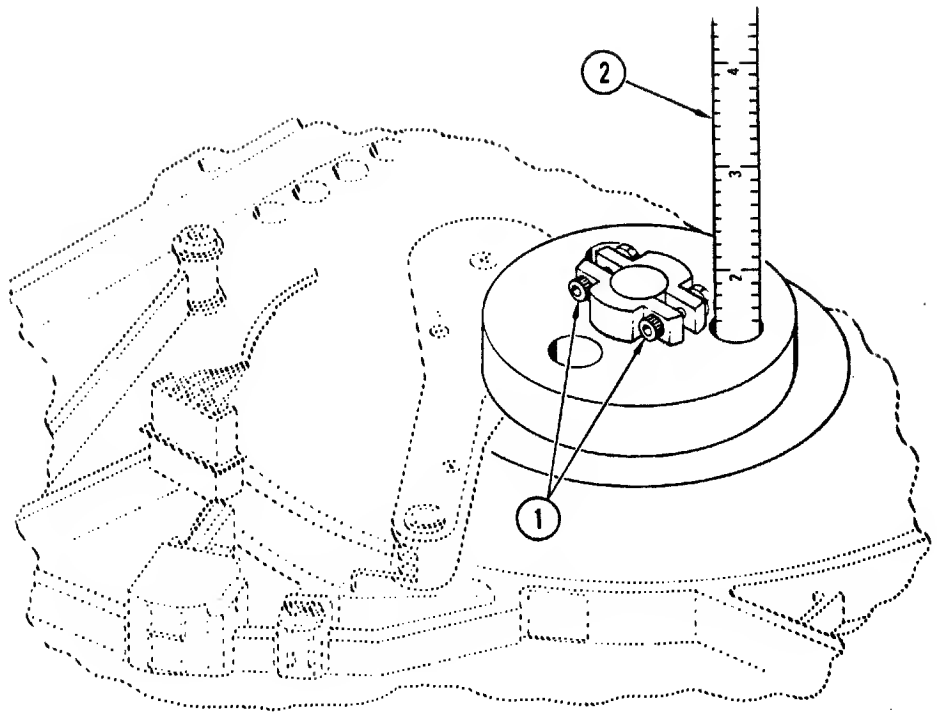
5.20 Take-Up Hub

5.20.1 Removal

1. Switch off ac power.
2. Place the tape unit in the operator access position. (See section 5.1.)
3. Open the top cover.
4. Measure the hub height and record the value.
5. Loosen the two screws (1) on the hub.

CAUTION: Take care when moving the tachometer toward the take-up hub. Do not let the tachometer strike against the take-up hub.

6. Gently move the tachometer away from the hub and lift the hub from the motor shaft.
7. Gently rest the tachometer on the motor shaft after you remove the hub.



5.20.2 Replacement

CAUTION: Do not force the top cover closed with the hub removed. Damage to the tachometer will occur.

Replace the take-up hub onto the motor shaft and perform the adjustment procedure.

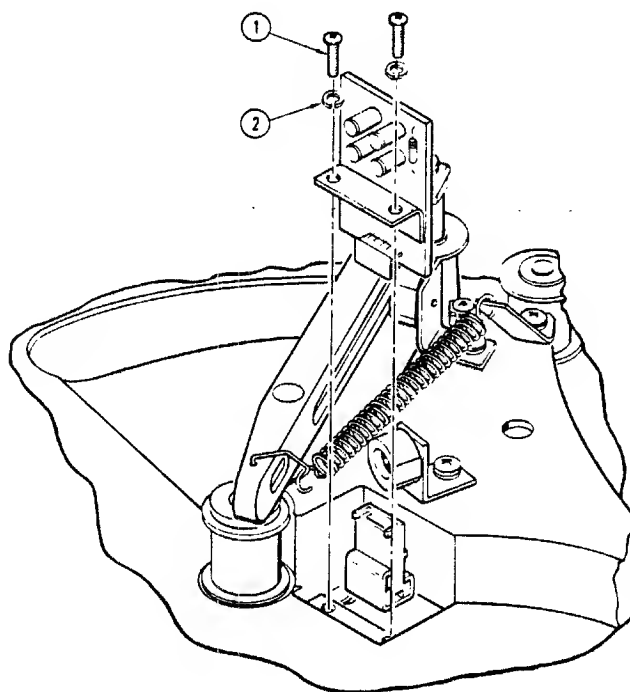
5.20.3 Adjustment

1. With the hub in place, insert the ruler scale (2) into the hole in the top of the hub.
2. Position the hub so that the ruler scale rests on the motor case and not on the mounting screws. If only the take-up hub was removed for repair or replacement, then use the value recorded in the previous removal steps and continue with step 4; if not, then proceed with step 3.
3. Adjust the hub for a clearance of 38 mm (1.5 inches) from the motor case to the top of the hub. Tighten the screws.
4. Check the hub height. If it is correct, load a tape and check to see if the tape is on the center of the hub. If it is not correct, loosen the screws and repeat steps 2 through 4 until it is correct.
5. Restore the unit to an operating position. (See section 5.3.)

5.21 BOT/EOT Sensor

5.21.1 Removal

1. Switch off ac power.
2. Place the tape unit in the operator access position. (See section 5.3.)
3. Remove the two screws (1) and the two lockwashers (2) attaching the sensor to the top plate.
4. Remove the EOT/BOT sensor and unplug the cable from the sensor.



5.21.2 Replacement

1. To replace the sensor, reverse the removal procedure. Make sure that the base of the sensor is parallel to the edge of the base casting.
2. Proceed to the Service Check.

5.21.3 Service Check

1. Switch off ac power.
2. Use diagnostic test 131 to check the operation of the EOT/BOT sensor.
3. Restore the unit to an operating position. (See section 5.3.)

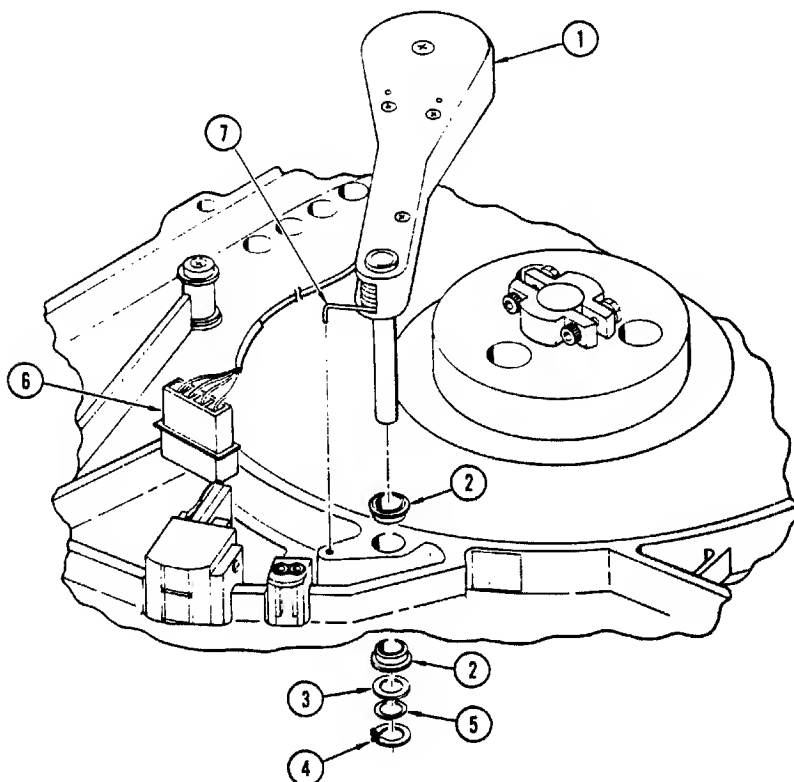
5.22 Tachometer

5.22.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Disconnect the tachometer signal cable (6).
4. With a retaining ring tool, remove the retaining ring (4) from the shaft. Be careful not to drop the shim(s) (3), retaining ring 4, or wave washer (5).

CAUTION: Do not let the tachometer strike sharply against the hub.

5. Remove the tachometer (1) and the spring (7) from the top of the tape unit.
6. If the upper and lower bearings (2) are replaced, use Loctite 601 or equivalent to set in place. Be careful when you remove or replace the bearings.



5.22.2 Replacement

1. Carefully insert the tachometer and its spring into the tape base plate.

2. Gently rest the tachometer onto the take-up hub and reverse the removal procedures.

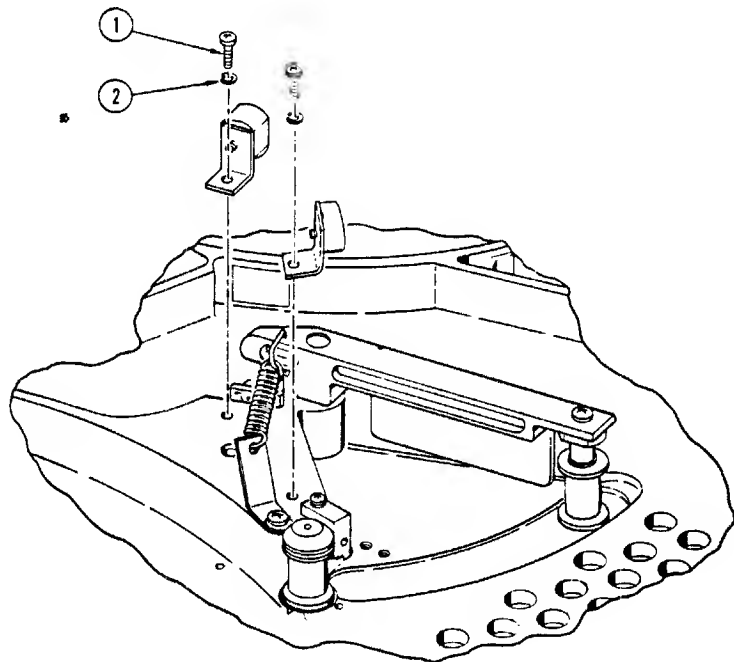
5.22.3 Adjustment

1. After the shim(s), wave washer, and retaining ring are in place, install the retaining ring onto the shaft. The wave washer should be compressed to about half its original height with the retaining clip.
2. Restore the unit to an operating position. (See section 5.3.)

5.23 Tension Arm Bumper

5.23.1 Removal

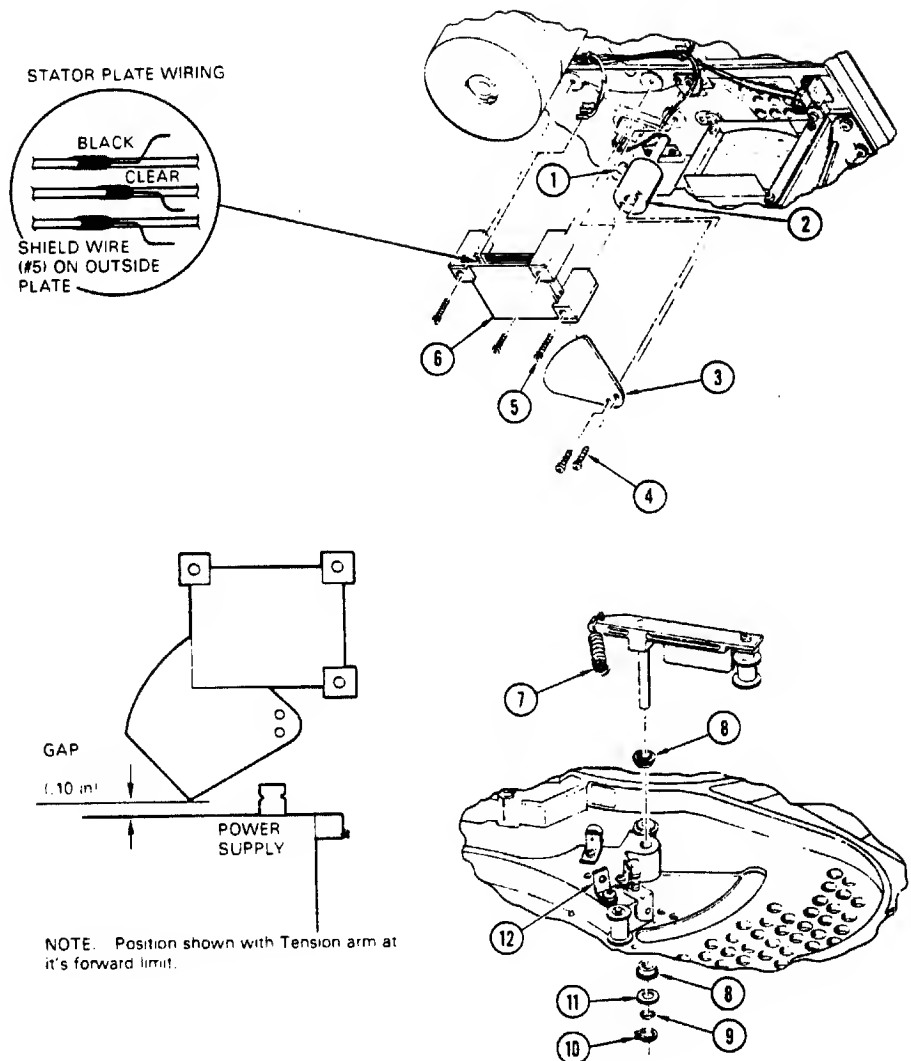
1. Switch off ac power.
2. Place the tape unit in the operator access position. (See section 5.1.)
3. Open the top cover and remove the screw (1) and lockwasher (2) from the defective bumper.



5.23.2 Replacement

1. Replace the bumper onto the unit base.
2. Position the bumpers so that each one contacts the tension arm squarely. Tighten the screws.
3. Place the unit in an operating position. (See section 5.3.)

5.24 Tension Arm/Air Capacitor Assembly



5.24.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the front panel. (See section 5.5.) Remove the main air duct.
4. Remove the screw that attaches the smaller air duct to the unit. Remove the air duct.
5. Remove the two screws (4), that attach the shutter blade (3) to the hub (2). Remove the shutter blade (3).

6. Record the position of and remove the clip wires on the stator plates. See illustration.
7. Remove the three screws (5). Remove the stator plate (6).
8. Loosen the screw (1), and remove the shutter hub (2) from the tension arm shaft.
9. From the top side of the unit, remove the spring (7) from the bracket (12).
10. From the bottom side of the unit, remove the retaining ring (10), wave washer (9), and shim(s) (11) from the shaft. Be careful not to drop any springs or washers.
11. Remove the tension arm from the unit. If the upper and lower bearings (8) are to be replaced, remove them from the unit and set in place with Loctite 601.

5.24.2 Replacement

Reinstall the tension arm/air capacitor assembly by reversing the removal procedures. When you install the shim(s), washer, and wave washer, check to see if the wave washer is compressed to about half its original height with the retaining ring installed. If it is not, add or remove any shim(s) to compress the wave washer to about half its original height.

Note: Replace shutter blade between the two plates closest to the casting.

5.24.3 Adjustment

1. Loosen the clampscrew (1), and remove the spring (7) on the air capacitor arm. Secure the tension arm to the front bumper.
2. Rotate the shutter blade (3) to within 2.5 mm (.10 inch) from the power supply enclosure.
3. Check the clearance on the shutter blade. Make sure that it does not rub on the stator plates. Tighten the screw (1).
4. Swing the tension arm to both limits of travel and check for free operation. If it binds, repeat the adjustment until the arm swings free to both limits of travel.
5. Replace the clip wires on the stator plates, the air ducts and the front cover.
6. Replace the spring (7) onto the arm. Load a tape to check for proper operation and restore the unit to an operating position. (See section 5.3.)

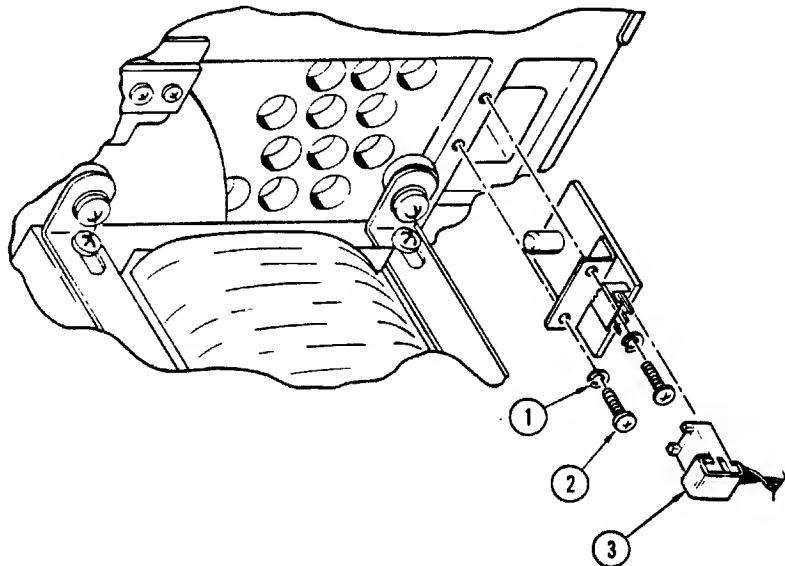
5.24.4 Service Check

Activate test 124 to display the compliance arm voltage on the alphanumeric display. Check the voltage with the arm in the rest position, the voltage displayed should be less than +14.2 volts. Move the arm forward until it contacts front bumper, the voltage should be greater than -14.2 volts. If the voltages are not correct, perform the adjustment procedure (5.24.3).

5.25 Tape-In-Path Transmitter

5.25.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the wire connector (3) from the tape-in-path transmitter.
4. Remove the two screws (2) and the two lockwashers (1) from the tape-in-path LED.



5.25.2 Replacement

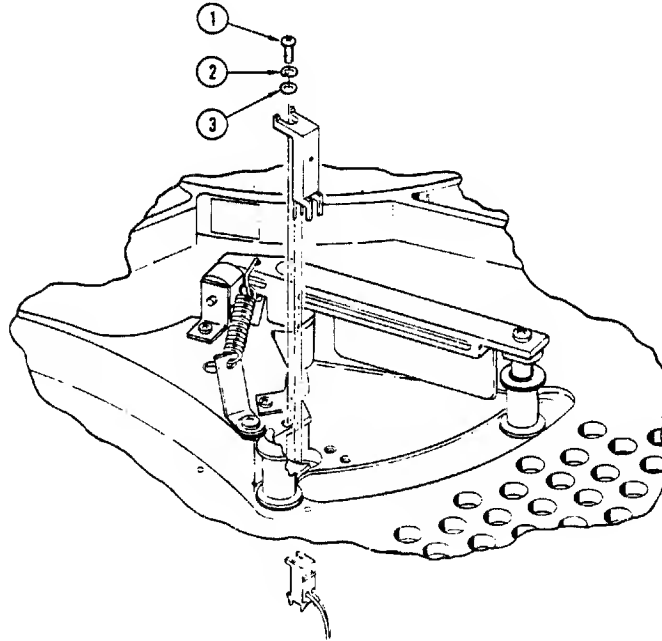
For replacement, reverse the above removal procedures.

5.26 Tape-In-Path Sensor

5.26.1 Removal

1. Switch off ac power.
2. Place the unit in the operator access position. (See section 5.1.)

3. Open the top cover and remove one screw (1), one lockwasher (2), and one washer (3) from the sensor.
4. Note the position of and remove the wire cable connected to the sensor.



5.26.2 Replacement

1. Reverse the following procedures for the tape-in-path sensor.
2. Proceed to the adjustment procedure.

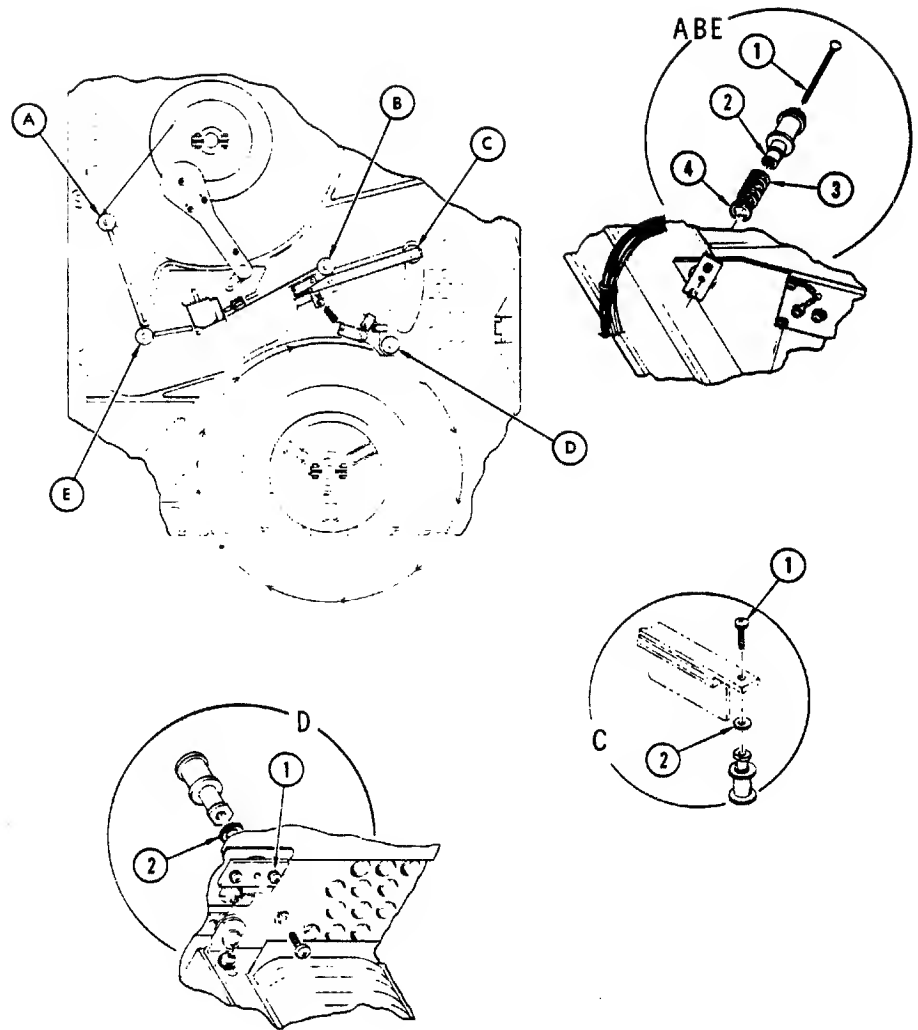
5.26.3 Adjustment

1. Place the unit in the service position. (See section 5.2.)
2. Switch on ac power.
3. Connect a volt meter to connector J9 on the Sense/Servo PWB. For PWB Sets A and B, connect the leads to pins 13 (signal) and 17 (ground). For PWB Set C, connect the leads to pins 15 (signal) and 1 (ground). You should get the following results:

CONDITION	RESULT
With tape loaded	< 0.1 Vdc
Without tape loaded	> 0.4 Vdc

4. Without any tape in front of the sensor, loosen the screw and adjust the sensor for maximum voltage. Tighten the screw.
5. Place the unit in an operating position. (See section 5.3.)

5.27 Tape Guides



5.27.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Locate the guide to be removed and follow the procedures.

Tape Guide A,B & E

1. Remove attaching screw (1), leaving shims (4) and spring (3) in place.
2. Remove roller guide assembly through top of top plate.

Tape Guide C

1. Remove attaching screw (1) while holding on to tape guide.
2. Carefully remove tape guide and washer (2) from beneath tension arm.

Tape Guide D

1. Remove attaching screw (1) and lockwasher.
2. Leave shims in place.
3. Remove tape guide assembly from top of top plate.

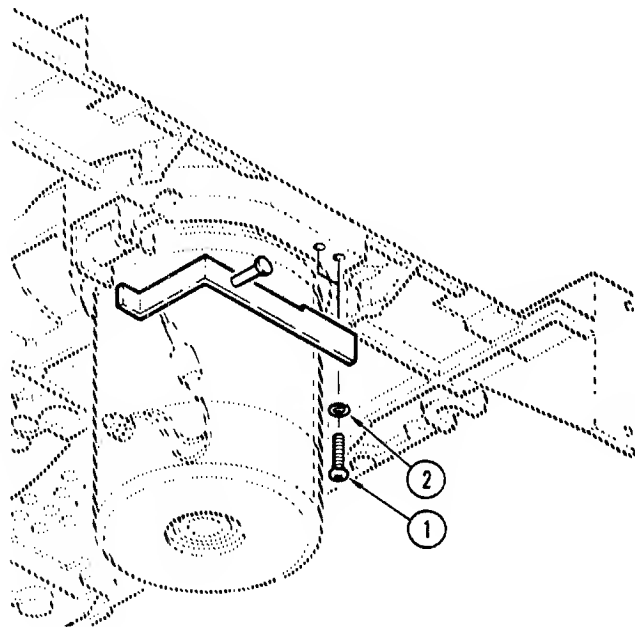
5.27.2 Replacement

1. Replace the tape guide with the original shim(s) by **reversing** the removal procedure steps.
2. Perform the Tape Tracking Procedure. (See section 5.38.)

5.28 Manual Hub Release Assembly

5.28.1 Removal

1. Switch off ac power.
2. Disconnect the ac line cord.
3. Place the unit in the service position. (See section 5.2.)
4. Remove the front panel. (See section 5.5.)
5. Remove the two screws (1) and two lockwashers (2) from the assembly.



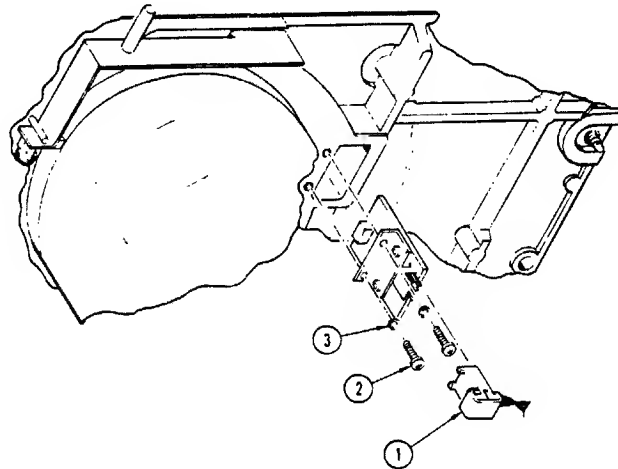
5.28.2 Replacement

Reverse the removal procedure for the hub release assembly.

5.29 Supply Reel Tab Sensor

5.29.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the cable (1) from the sensor.
4. Remove the two screws (2) and two lockwashers (3) from the tab sensor. Carefully remove the tab sensor from the unit.



5.29.2 Replacement

1. Reverse the above removal procedures for replacement.
2. Proceed to the service check.

5.29.3 Service Check

1. Connect a volt meter to connector J9 on the Sense/Servo PWB. For PWB Sets A and B, connect the leads to pins 14 (signal) and 17 (ground). For PWB Set C, connect the leads to pins 14 (signal) and 1 (ground). You should get the following results:

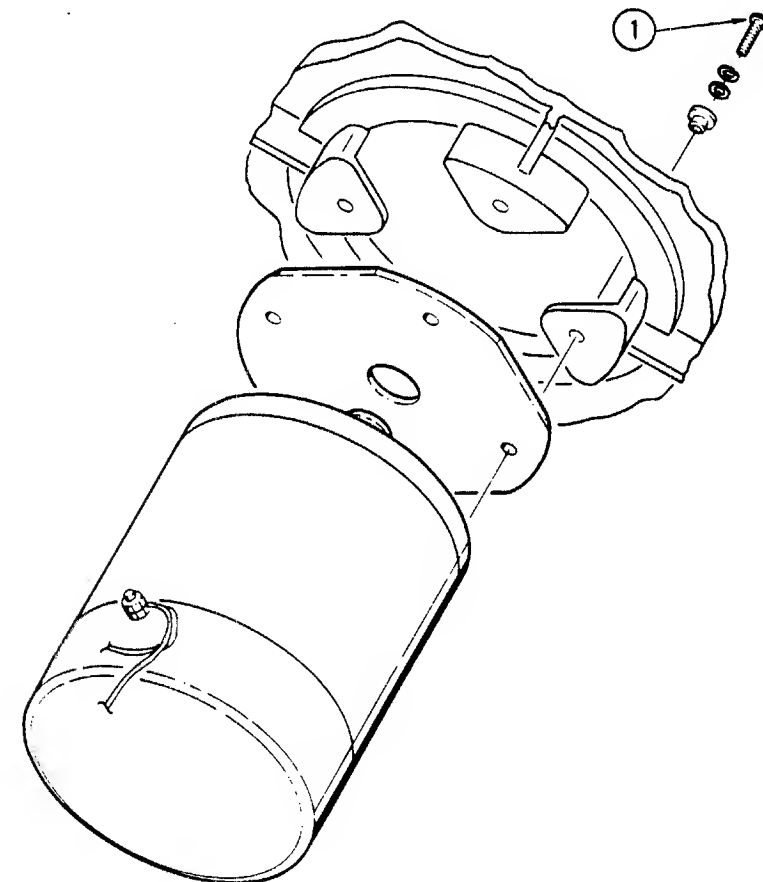
CONDITIONS	RESULTS
Reflector	> 0.5 Vdc
No reflector	< 0.1 Vdc

2. Activate test 131 with no tape on the supply hub. (See section 4.1.3 for diagnostic test).

5.30 Take-Up Motor

5.30.1 Removal

1. Switch off ac power.
2. Remove the ac power cord.
3. Place the tape unit in the service position.
4. Remove the tape unit boards. (See sections 5.34 through 5.37.)
5. Remove the take-up hub. (See section 5.20.) Loosen, but do not remove, all of the screws (1) from the motor.
6. Remove the power supply cover. Label and disconnect the take-up motor wires.
7. Using one hand as a support, remove the four screws and washers; with the other hand, remove the motor. Save the motor insulator and screws for replacement.



5.30.2 Replacement

1. Reverse the removal procedure for replacement with the motor insulator removed earlier.
2. Perform the take-up hub adjustment procedure. (See section 5.20.3.)
3. Perform Servo Offset adjustment procedure. (See section 5.34.4.)

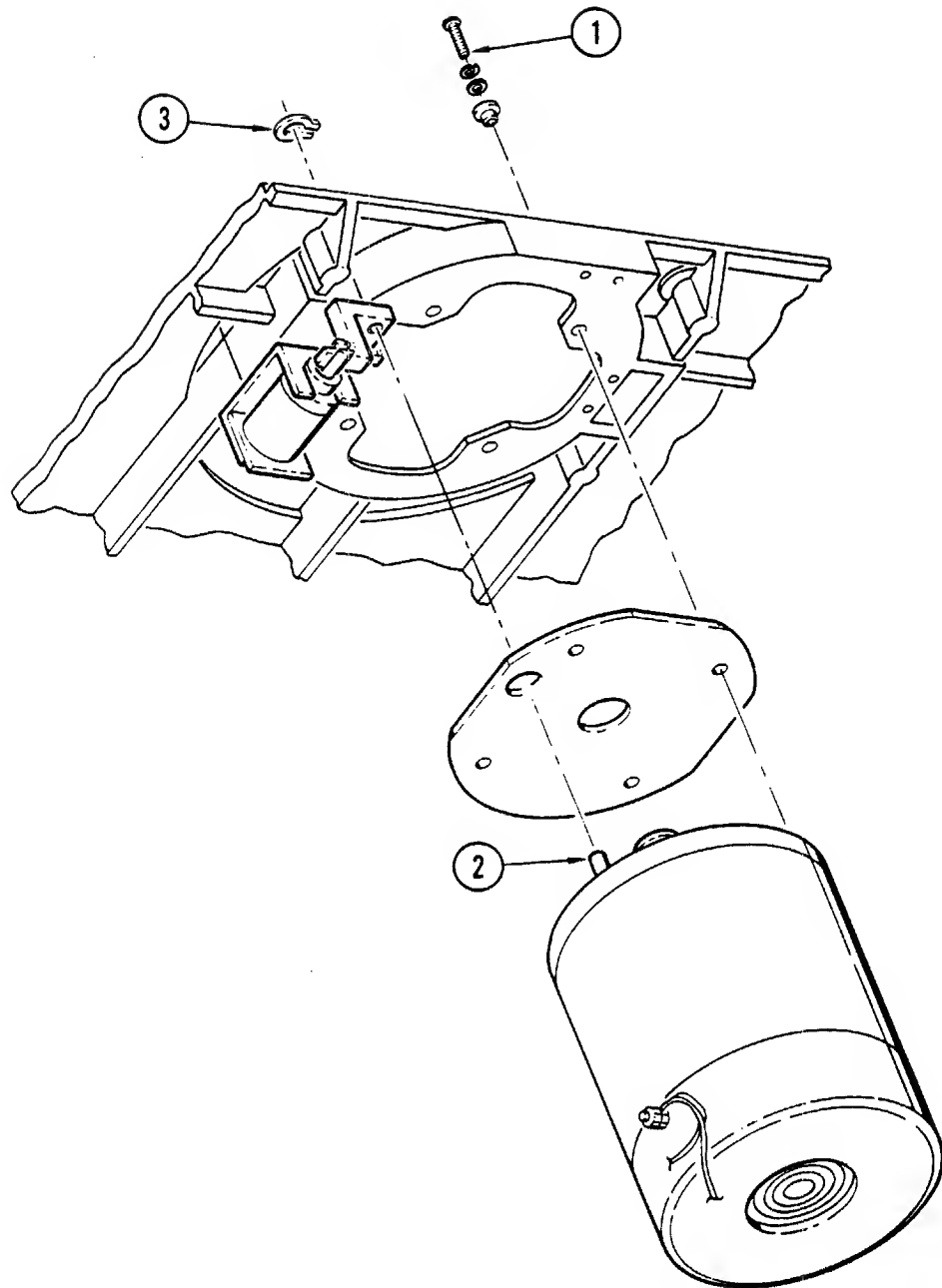
5.31 Supply Motor

5.31.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Loosen the two screws on the supply hub and lift the hub off of the shaft. (See section 5.17.)
4. Remove the clip (3) on the hub lock pawl shaft.
5. Disconnect the supply motor wire cable.

CAUTION: Do not drop the motor onto tape control board.

6. Loosen, but do not remove, the four screws (1) from the motor. With one hand as a support, remove the four screws and washers with the other hand. Lower the supply motor while simultaneously slipping the pawl off its shaft.
7. Save the motor insulator and screws for replacement. If the replacement motor does not have the hub lock pawl shaft 2, remove it from the old motor and place it on the new motor.



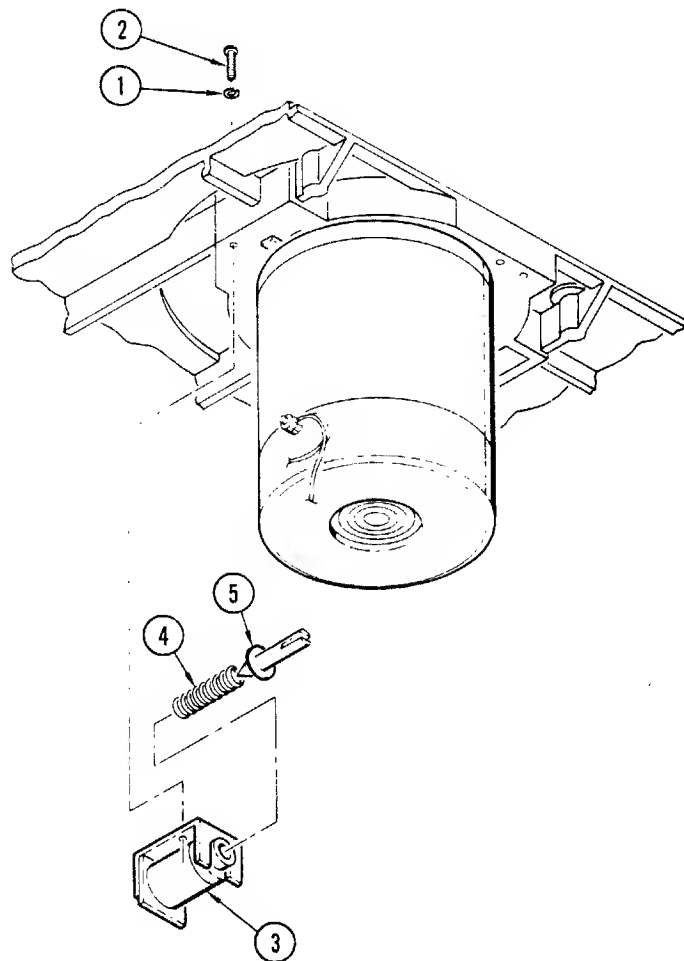
5.31.2 Replacement

1. Install the motor and the insulator with the screws removed earlier.
2. Tighten the screws until snug. Place the supply hub on the shaft and check to see if the motor is centered. Adjust the motor as necessary to center it.
3. Remove the hub and tighten the screws (1). Perform the supply hub adjustment. (See section 5.17.3.)
4. Perform Servo Offset adjustment procedure. (See section 5.34.4.)

5.32 Hub Lock Solenoid

5.32.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Locate and disconnect the solenoid wires. Note the position of the wires for replacement.
4. Remove the two screws (2) and the two lockwashers (1) from the top of the tape unit.
5. Remove the solenoid (3) and the plunger spring (4).



5.32.2 Replacement

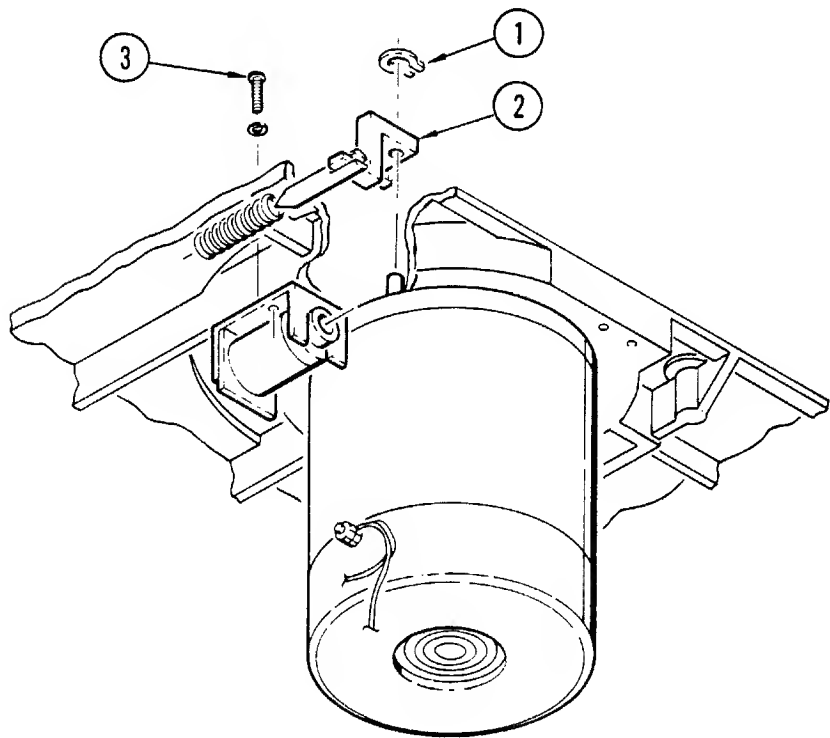
Reverse the removal steps for the hub lock solenoid.

Note: Make sure that the pawl pivots freely. If not, loosen screws (2) and adjust the solenoid so that the pawl pivots freely.

5.33 Hub Lock Pawl

5.33.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove the supply hub. (See section 5.17.)
4. Remove the clip 1 from the pawl shaft.
5. Remove the hub lock solenoid. (See section 5.32.)
6. Lift the pawl assy. (2) up and out of the tape unit housing.



5.33.2 Replacement

1. Reverse the removal procedures for the hub lock pawl.

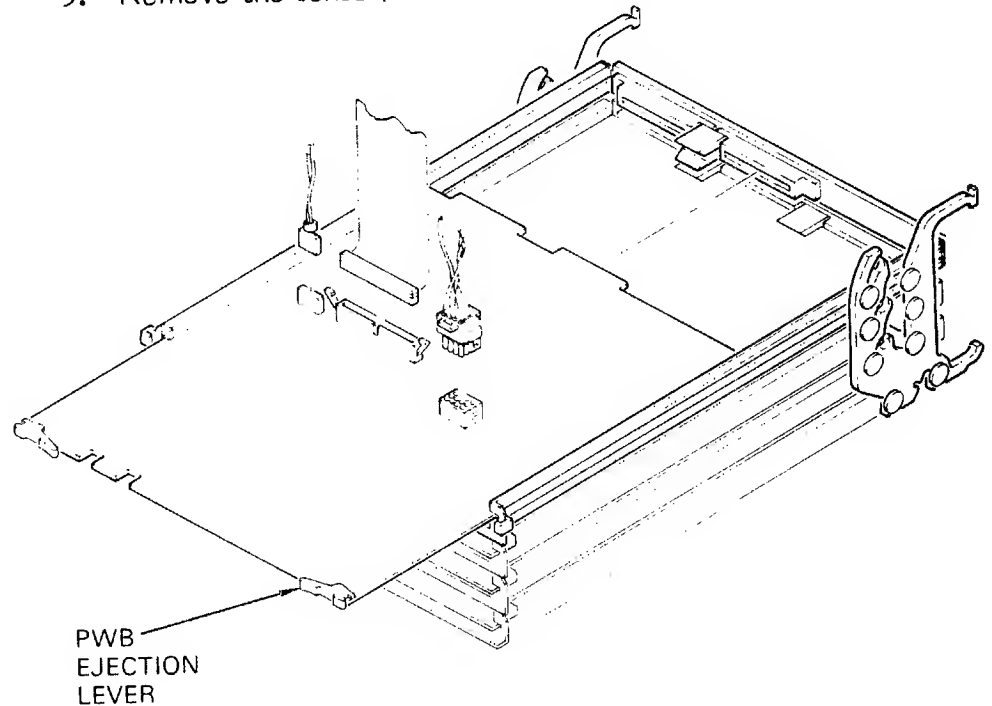
Note: Make sure the pawl pivots freely. If not, loosen the two screws (3) and adjust the solenoid so that the pawl pivots freely.

2. Perform the supply hub adjustment. (See section 5.17.3.)

5.34 Sensor/Servo Board

5.34.1 Removal

1. Switch off ac power.
2. Place the unit in the service position. (See section 5.2.)
3. Remove all cables from the sensor/servo board.
4. Grasp the PWB ejection levers at the front corner of the board and pull outward to release the board from the edge connections at the rear of the PWB rack.
5. Remove the sensor/servo board from the PWB rack.



5.34.2 Replacement

Reverse the removal procedure of the sensor/servo board.

Note: Make sure that all connectors are properly replaced before turning on ac power.

5.34.3 +5Vdc Adjustment (961334-003 board only)

1. Switch on ac power.
2. Remove tape and place the unit in the service position. (See section 5.2.)
3. Connect a DVM to test point 42 (+5Vdc reference) and test point 44 (ground). Adjust R85 on the sensor/servo board for +5.1Vdc.

5.34.4 Servo Offset Adjustment

1. Switch ac power on.
2. Remove tape from unit if installed.

CAUTION: Use a battery operated or ac ground isolated DVM when checking the servo offset voltage. Damage to the servo circuits will result if a DVM with common ac ground is used.

NOTE: Steps 3 and 4 cannot be done if -009 or higher firmware is installed.

3. On the Sensor/Servo Board, connect the DVM leads to J-1 pins 7 and 10 for PWB Set A, the right-hand side of C194 and C197 for PWB Set B, or TP-37 and TP-38 for PWB Set C to check the supply motor offset voltage. The voltage should be 0.0 ± 0.035 volts. Use 2-volt scale.
4. Connect the DVM leads to J-1 pin 8 and pin 11 for PWB Set A, the right-hand side of C195 and C196 for PWB Set B, or TP-35 and TP-36 for PWB Set C to check the take-up motor offset voltage. The voltage should be $0.0, \pm 0.035V$.
5. If adjustment of either voltage is required, proceed as follows:

CAUTION: Follow these instructions to the letter. Failure to do so could result in your GCR being inoperable.

Note: Do not enter test 515 to check offset values without completing the entire adjustment procedure since all previously stored values are cleared upon entry.

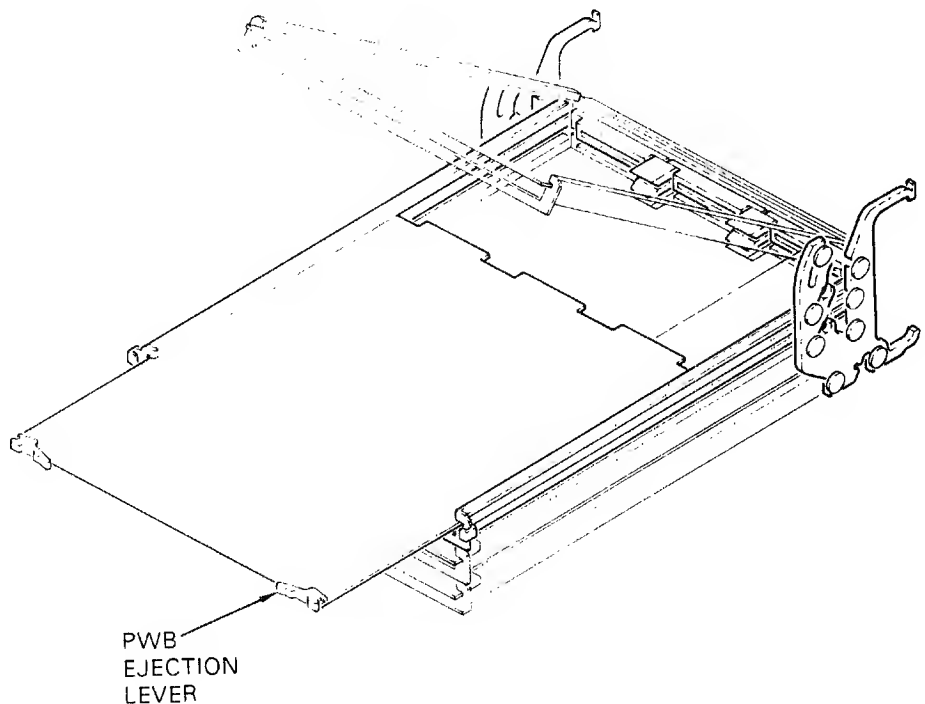
- a. Enter diagnostic test code 455155 using the front panel switch/indicators.
- b. Enter password 54524 using the front panel switch/indicators.
- c. The O supply message will be momentarily displayed, then the SDAC +000 (supply motor DAC offset value) message will appear.
- d. Connect the DVM leads to J-1 pin 7 and pin 10 for PWB Set A, the right-hand side of C194 and C197 for PWB Set B, or TP-37 and TP-38 for PWB Set C.
- e. Press the Load switch to increase, or the Unload switch to decrease the voltage until it is as close to zero as possible. The voltage must be within the $\pm 0.035V$ range.
- f. Press the Write Enable/Test switch to enable take up servo offset adjustment. The messages DONE ... 0 TAKE UP ... TDAC +000 should be displayed.

- g. Connect the DVM leads to J-1 pin 8 and pin 11 for PWB Set A, the right-hand side of C195 and C196 for PWB Set B, or TP-35 and TP-36 for PWB Set C.
- h. Repeat step e.
- i. Press the Write Enable/Test switch again to return the unit to normal operating status and return unit to field mode by performing Test 542.
- j. Switch ac power off to store the new offset values in NOVRAM. The new adjustment can be checked by repeating steps 3 and 4 of this procedure.

5.35 CPU/MMU Board

5.35.1 REMOVAL

1. Switch off ac power.
2. Place the unit in the service position.
3. Lift sensor/servo PWB and frame assembly and push toward rear of chassis to lock in the raised position.
4. Grasp the PWB ejection levers at the front corners of the CPU/MMU board and pull outward to release the board from the edge connectors at the rear of the PWB rack.
5. Remove the CPU/MMU board from the PWB rack.



CAUTION: Caution should be used when removing the NOVRAM because it is a static sensitive device. Use proper handling procedures.

Note: By removing the NOVRAM chip (U25J) and reinstalling it into the new CPU/MMU board, the Servo Offset adjustment and NOVRAM settings do not need to be performed.

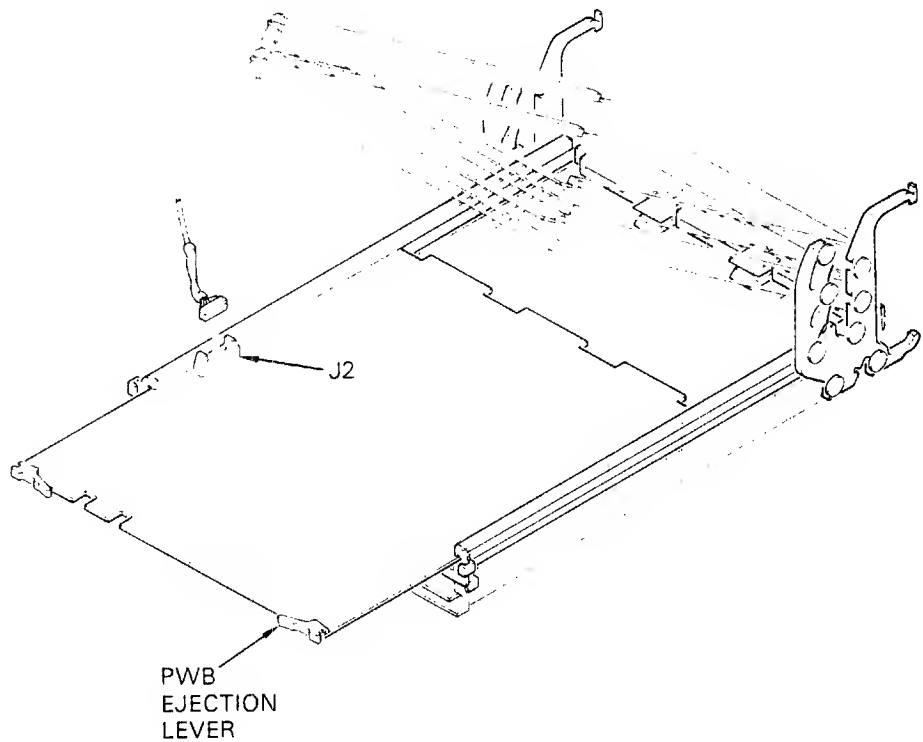
5.35.2 Replacement

1. Reverse the removal procedure for the CPU/MMU board.
2. Perform Servo Offset adjustment procedure (see section 5.34.4.), unless you keep NOVRAM from removed CPU PWB.

5.36 Data Board

5.36.1 Removal

1. Switch off ac power.
2. Place unit in the service position. (See section 5.2.)
3. Lift the sensor/servo PWB and frame assembly and push toward rear of chassis to lock in the raised position.
4. Repeat the previous step with the CPU/MMU board.
5. Remove the read head assembly cable from J2 on the data board.
6. Grasp the PWB ejection levers at the front corners of the data board and pull outward to release the board from the edge connectors at the rear of the PWB rack.
7. Remove the data board from the PWB rack.



5.36.2 Replacement

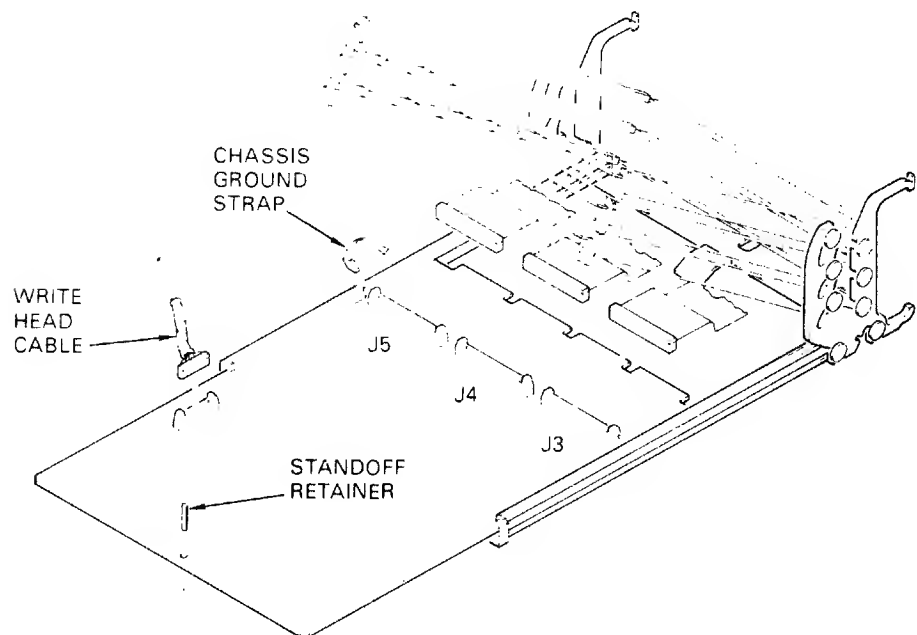
Reverse the removal procedure for the data board.

1. Run Test 513 (see section 4.4.17.)

5.37 CIF Write

5.37.1 Removal

1. Switch off ac power.
2. Place unit in the service position. (See section 5.2.)
3. Lift the sensor/servo PWB and frame assembly and push toward rear of chassis to lock in the raised position.
4. Repeat the previous step with the CPU/MMU and data boards.
5. Remove the connectors from J3, J4, and J5 at the rear of the CIF/write board.
6. Remove the chassis ground straps from the back of the CIF/write board.
7. Remove the write head cable from the CIF/write board.
8. Unscrew the standoff retainer at the center front edge of the board and slide the CIF/write board out of the PWB rack.

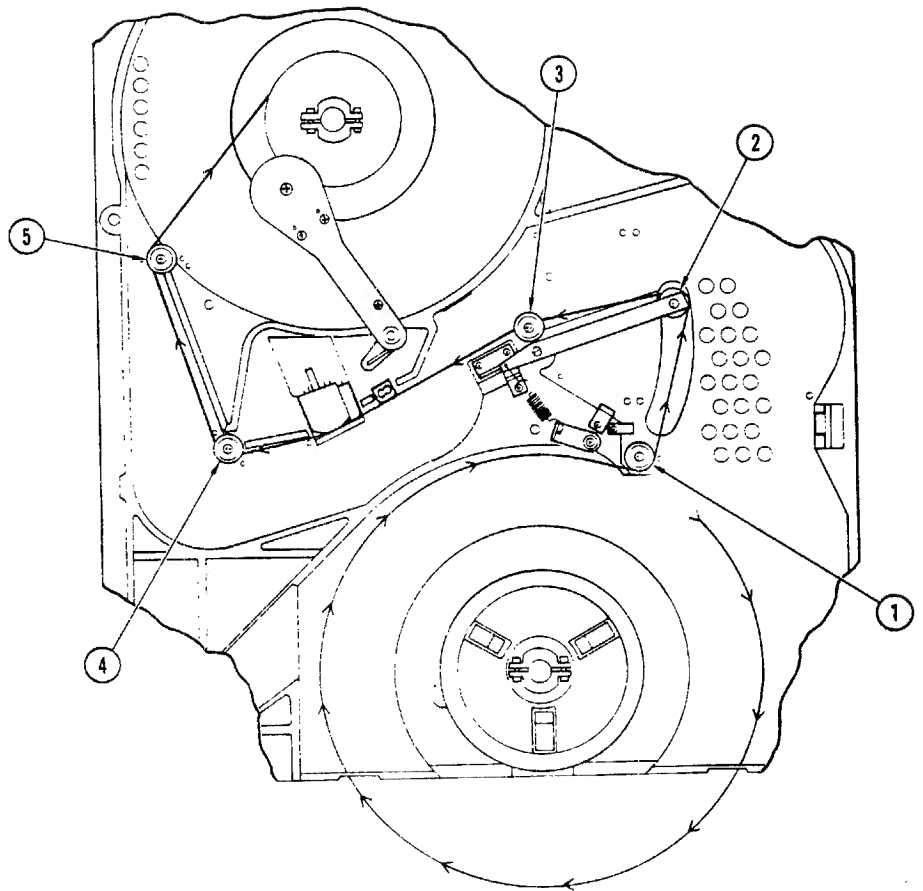


5.37.2 Replacement

Reverse the removal procedure for the CIF/write board.

1. Run Test 513 (see section 4.4.17.)

5.38 Tape Tracking Procedure



1. Switch on ac power.
2. Insert and load a new tape. Ensure that the supply reel is properly seated on the supply hub.
Note: A used tape may have damaged or weak edges which could adversely affect its tape-path tracking characteristics.
3. Activate test 233 to disable door and top cover lock. (See section 4.4)
4. Open the top cover and front panel door.
5. Press the Density Select switch to select the 1600 bpi mode.
6. Activate test 212 to write data in the forward direction. (See section 4.1.4.)
7. Observe the tape as it unwinds from the supply tape reel. If necessary, adjust the supply hub height (5.17.3) to eliminate any interference between the tape and supply reel flanges.

8. If tape is not centered on guide, turn power switch to OFF, and remove guide (2) from compliance arm. (See section 5.27.1.)
9. Add or reduce thickness of shims as required to compensate for off-center position and reinstall guide on compliance arm. Repeat as necessary to obtain correct centering of tape on guide (2).
10. Run tape forward and check for edge curl on guide (3). If curl is present on lower washer, turn power switch to OFF and increase shims under roller guide (1). If curl is present on upper washer of guides (3), decrease shim thickness under roller guide (1). Resume forward tape motion and recheck tape position. Repeat this step until tape tracks smoothly around guide (3).
11. Depress lower washer on guide (3) and check for optimum movement of tape away from top washer of 0.005 inch. If necessary, reshim guide (2) to maintain proper tape centering.
12. Run tape in forward direction and check for edge curl on guide (4). If curl is present, turn transport power to OFF and add or remove shims on guide (5). Normally, improper alignment of guides (1) and (2) will show up as tracking problem on guide (3).

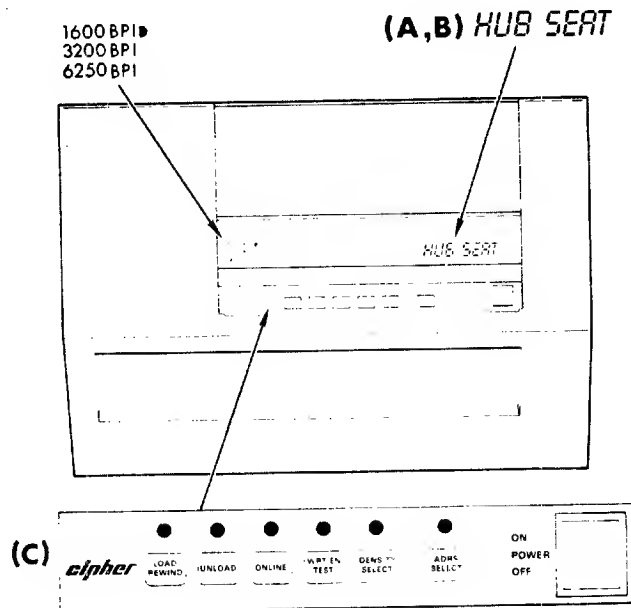
Note: Curl on guide (4) can be caused by improper alignment on any other guide in the tape path. If tracking has been verified on guide (3), tape curl on guide (4) is probably caused by misalignment of guides (1) and (2) will show up as tracking problems on guide (3).
13. Run tape in reverse direction (test 212) and check for tape curl on all edges.
14. Depress lower washer on guides (3), (4), and (5) and check for optimum tape movement, away from top washer, of 0.005 inch.
15. Add or delete shims on guides (1), (2) and (5) as required to eliminate edge curl on all rollers and reverify forward tape path alignment by checking for maximum tape shift on guide (2) of ± 0.015 inch.
16. Check head azimuth and read skew. (See section 5.18.3.)

Select switch to select the 1600 bpi mode.
17. Activate test 212 to write data in the forward direction. (See section 4.1.4.)
18. Observe the tape as it unwinds from the supply tape reel. If necessary, adjust the supply hub height (5.17.3) to eliminate any interference between the tape and supply reel flanges.

Chapter 6. Operation

6.1 Operator Display Panel

The operator display panel contains an eight-character alphanumeric display (A) that provides information to the operator during normal operation and diagnostic testing. Error messages (B) give more specific information about problems. Indicators (C) alert the operator to any problems in the loading or unloading operation.



6.1.1 Switches/Indicators

Load-Rewind Switch/Indicator

Press the Load/Rewind switch to load or rewind the tape. The indicator flashes as the tape loads and remains lit when loading is complete.

Unload Switch/Indicator

Press the Unload switch to remove tape from the tape path. The indicator flashes as the tape rewinds and remains lit when the tape path is clear.

On-line Switch/Indicator

Press the On-line switch to place the tape drive under host system control. The On-line indicator then lights. Press the On-line switch a second time to remove the tape drive from system control. The On-

line indicator then shuts off. While on-line, the tape drive does not respond to other front panel switches.

Write Enable-Test Switch/Indicator

When this indicator is lit, a write-enable ring is installed on the tape reel and information can be written to or erased from the tape.

If the unit is in the off-line mode and the Test switch is pressed, the indicator flashes to signal the operator that the unit is in the diagnostic mode. Refer to section 4.1 for a description of the available tests. When the Test switch is pressed again, the unit exits the diagnostic mode.

Address Select Switch

Press the Address Select switch to determine the tape drive address for each M990 when more than one is connected to the same system. To change the address, continue to press the Address Select switch and press the On-line switch to reset the address to 0. Press the On-line switch again to increment the address until the desired number is reached. The address selected is displayed on the alphanumeric display as UNIT X, where X is 0 through 7. Each tape drive connected to the same system must have a unique address.

Density Select Switch/Indicator

Press the Density Select switch to select the operating density. The available densities are PE 1600 bpi, PE 3200 bpi, and GCR 6250 bpi. The selected density is indicated by the density LEDs. This switch can only be used when the tape is at load point.

Density LED Lights

1600 bpi
3200 bpi
6250 bpi

Found Density

This denotes the density that is currently recorded on the tape. Upon completion of the load sequence, the alpha display will reflect the found density with the message "ID XXXX." "NO ID" will be displayed if a blank tape or invalid format is detected. This found density message continuously displays until execution of an interface command or a front panel diagnostic. The message can be restored by cycling the On-Line Switch to the on-line state when the tape unit is idle.

Commanded Density

This denotes the density that has been selected for recording. The density LED lights on the left side of the display panel denote the last commanded density (1600 bpi, 3200 bpi, or 6250 bpi). Density is commanded by one of four means.

1. Power-up default: Selected by the internal processor when power is applied to the tape drive. The desired power-up density is stored as NOVRAM option 10.
2. Front Panel: Selected by the operator using the density select switch when the drive is unloaded or with tape loaded, offline, and positioned at the beginning of tape.
3. Interface: Selected remotely by the host system using the five command lines (IREV, IWRT, IWFM, IEDIT, IERASE). This method is system dependent and also requires NOVRAM option 19 enabled.
4. Internal: The tape drive internally commands the recording density under one condition. A read operation from beginning of tape, followed immediately by a write operation, switches to commanded density (if necessary) to match the density that was read. If a rewind precedes the first write operation, the commanded density is not switched. This feature ensures that an operator or system error does not create a mixed density tape.

Operating Density

This denotes the density that is read from or written to the tape. During a read operation from beginning of tape, if the commanded density does not agree with the found density, the density LED lights will automatically switch to reflect the found density. Using this approach, the LED lights always indicate the current operating density of the tape drive when active. This allows the operator to identify procedural problems that could result in tape generation in an unspecified density.

6.1.2 Alphanumeric Display Panel

When the drive fails to operate properly, the indicators on the front panel flash patterns to alert the operator of an error condition. Error messages are also displayed by the alphanumeric display and describe the condition that must be corrected to allow normal operation. To reset the error,

press the Load/Rewind or Unload switch. Press the Load/Rewind switch again to restart the load sequence.

6.1.3 Error Conditions

Three types of error conditions can be displayed.

1. Soft errors
2. Medium errors
3. Hard errors

Soft errors are usually caused by operator error or a slightly damaged tape that prevents completion of the autoloader sequence.

Medium and hard error messages are described in Section 6.4. The following alphanumeric display messages indicate soft error conditions that can usually be corrected by the operator.

HUB SEAT

If this message is displayed, check that the tape reel is positioned properly on the supply hub. After correcting the reel alignment, press the Load/Rewind or Unload switches to reset the error.

LOAD FAILURE

If this message is displayed, the unit failed to load tape. Inspect the tape leader for damage. Refer to section 6.2.1.

Once the tape leader has been paired, press the Load/Rewind or Unload switches to reset the error. If the unit still does not load tape properly, refer to section 6.2.4.

TAPE STUCK

If this message is displayed, the unit failed to unwind tape from the supply reel into the tape path. Check the tape leader to make sure that it is properly crimped. Refer to section 6.2.1. Press the Load/Rewind, Unload, or Test switches to reset the error.

NO DOOR LOCK

If this message is displayed, you tried to load the tape reel while leaving the tape access door or the top cover open. After closing the tape access door and top cover, press the Load/Rewind or Unload switches to reset the error.

REEL UPSIDE DOWN

If this message is displayed, the tape reel was inserted upside down. Insert the tape with the write-enable ring down. Press the Load/Rewind or Unload switches to reset the error.

NO BOT

If this message is displayed, the unit could not locate the load-point marker within the first 35 feet of tape. Make sure that the marker is at least 16 feet from the leading end of the tape. Press the Load/Rewind or Unload switches to reset the error.

NOT ENOUGH TAPE ON TAKE-UP

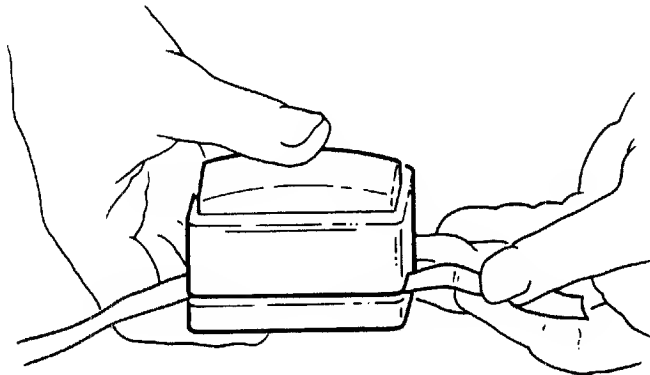
If this message is displayed, the unit does not have any tape in path while attempting to do a manual load.

6.2 Operation

6.2.1 Preparing Magnetic Tape

Prepare the leading end of the magnetic tape using the tape leader tool (Part No. 209990-500) shown below. This tool shapes the tape so that the drive can load tape automatically.

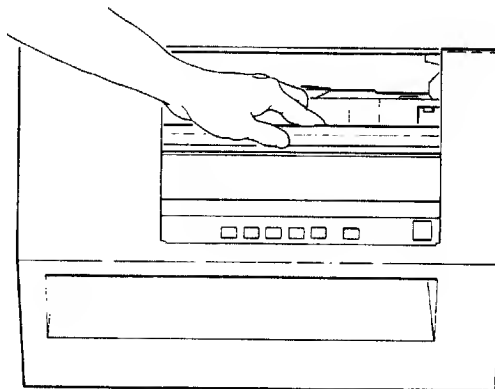
Place the tape in the slot and squeeze the tool as shown.



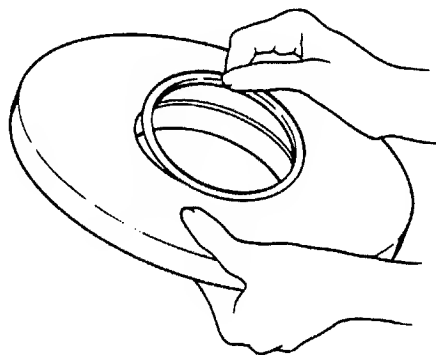
6.2.2 Loading Tape

1. If the power is off, switch it on.

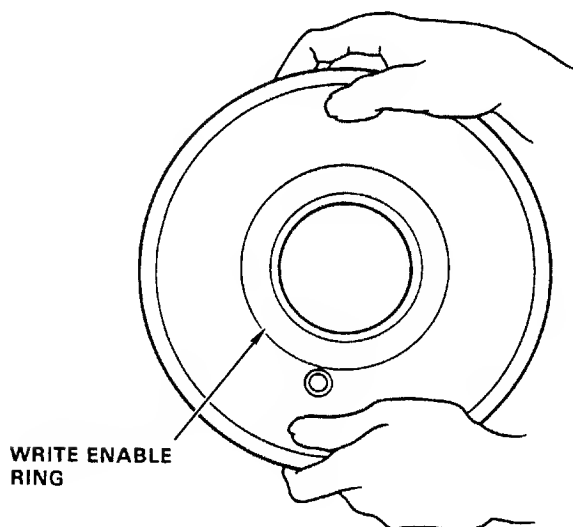
2. Open the tape access door by gently pressing down on the top (center) of the door.



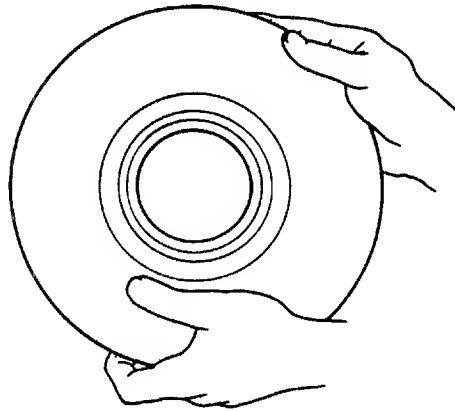
3. If you intend to write data on the tape, place a write-enable ring in the slot on the back of the tape reel.



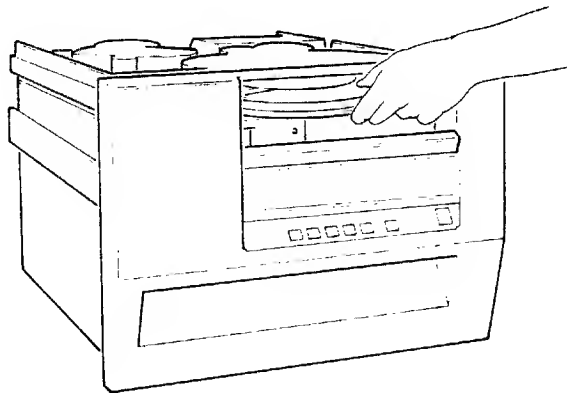
4. Make sure that the tape is wound completely onto the reel.



5. Hold the tape reel so that the write-enable ring is down.



6. Insert the tape reel so that it lies flat inside the front opening. The reel should lie evenly on the hub.



7. Close the tape access door. The drive does not load the tape if this door is open.
8. Press the Load/Rewind switch. The load indicator flashes while the tape loads and remains lit when loading is complete. During the auto-load sequence, the alphanumeric display will present the word **LOADING**. When the sequence is complete, the Density is displayed for 15 seconds.

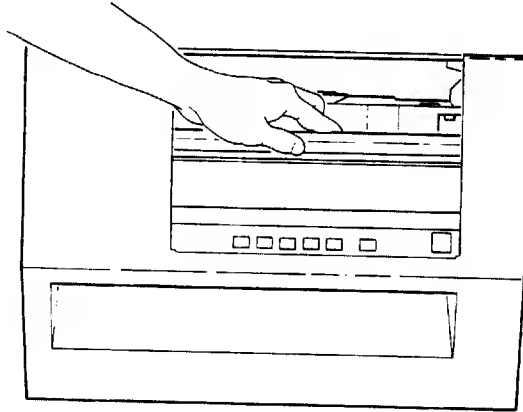
CAUTION: The top cover and front panel door are locked while the tape is loading and during operation.

6.2.3 Unloading Tape

1. Make sure that the tape access door and the top cover are closed.
2. Press the Unload switch.

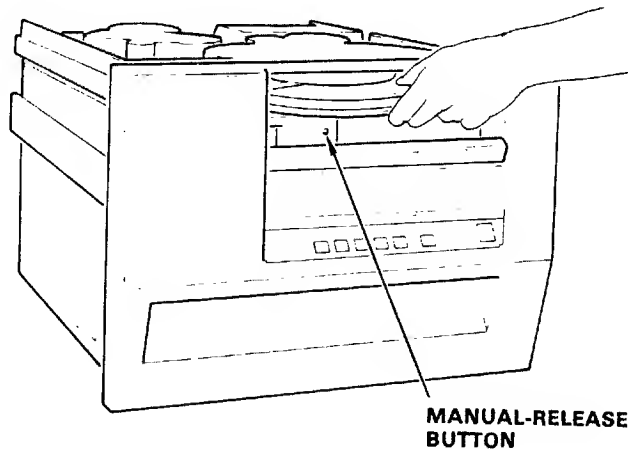
CAUTION: The top cover and tape access door are locked while the tape is unloading.

3. Open the tape access door when the Unload indicator remains lit continuously.



Note: If an indicator other than the Unload indicator flashes at this time, refer to section 6.1.2.

4. Remove the tape reel.



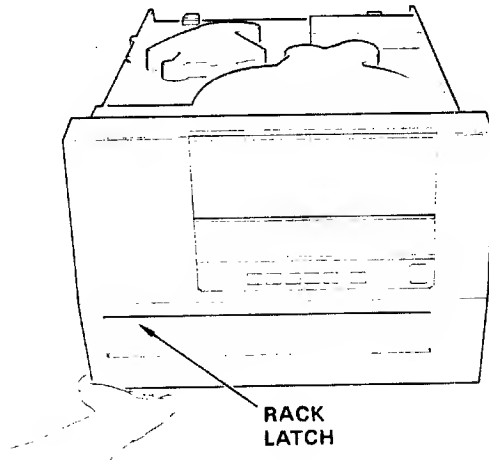
If the reel is locked to the hub, press and hold the manual release button, located behind the front panel door on bottom left-hand side of tape reel opening, while rotating the tape reel counterclockwise.

5. Close the tape access door.

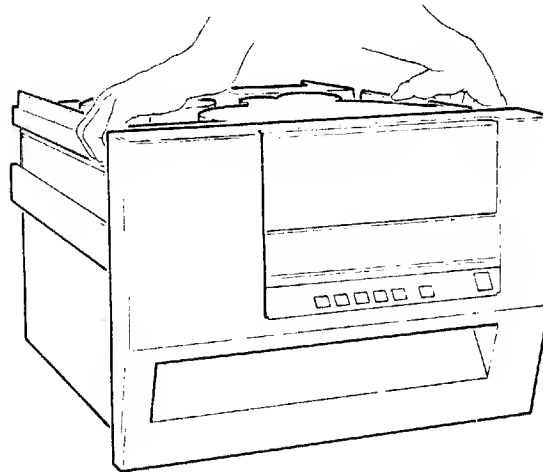
6.2.4 Loading Tape Manually

Note: Do not load tape manually if any of the indicators are flashing. Refer to section 6.1.2 of the manual if any of the indicators are flashing.

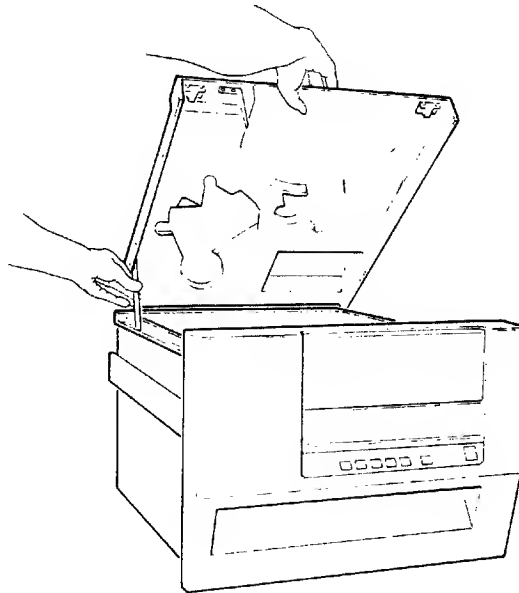
1. If the power is on, press the power switch to remove power from the drive.
2. Release the rack latch just inside the lower left side at the front panel. Pull from behind the lower left-hand side of the front panel and slide the tape drive out of the rack.



3. Slide the tape drive forward until it is fully extended from the rack.
4. Grasp the lower edges of the top cover and lift.

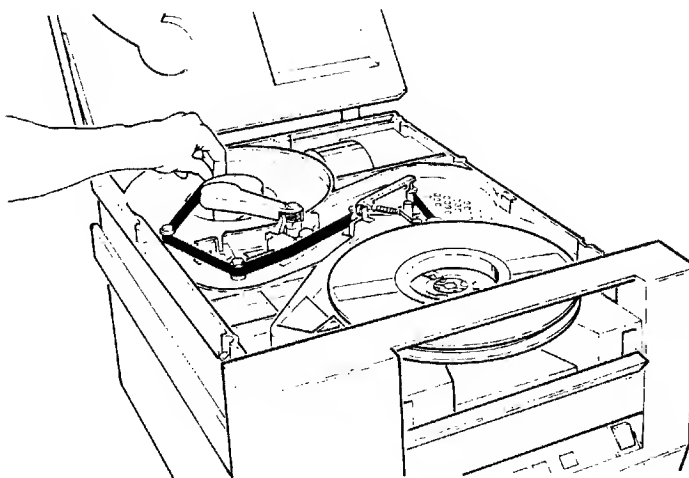


5. While holding the top cover in the raised position, place retainer bar in its slot next to the tape path.



6. If you intend to write data on the tape, place a write-enable ring on the tape reel.
7. Hold the tape reel so that the write-enable ring is down.
8. Open the tape access door and insert the tape reel so that it lies flat inside the front opening.
9. Depress and hold the manual unlock button, located behind the front-panel door on the bottom left side of the tape reel opening, and simultaneously rotate the supply hub clockwise until the supply hub is locked in place.
10. Press the power switch to apply power to the drive.
11. Pull the tape around the first two roller guides.
12. Pull the tape around the third roller guide and across the read/write head.

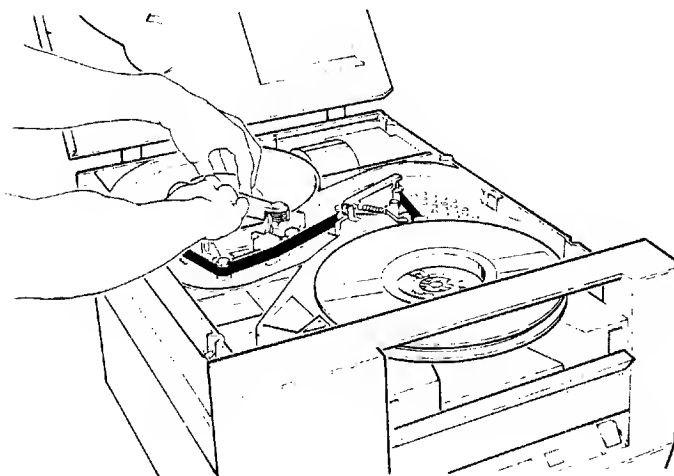
13. Pull the tape around the next two roller guides.



14. Pull the tachometer away from the take-up hub.

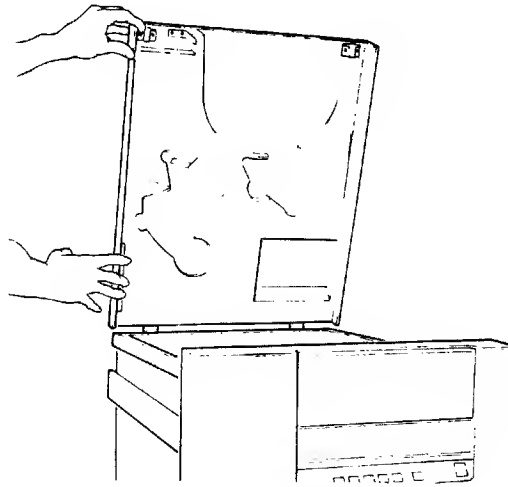
CAUTION: Do not release the tachometer while holding it away from the take-up hub. It could be damaged if it strikes sharply against the hub.

15. While holding the tachometer away from the hub, press the end of the tape against the hub and turn the hub clockwise until the end of the tape is held by the next layer of tape. Turn the hub six revolutions clockwise.

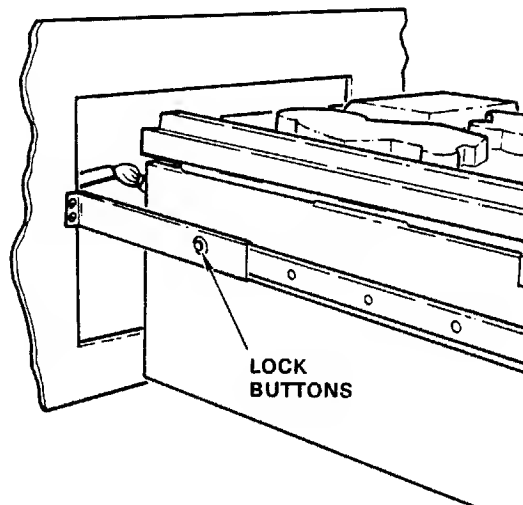


16. Gently place the tachometer against the hub.
17. Lift the top cover until the retainer bar is clear of its slot.

18. While holding the top cover in the raised position, push the retainer bar back and up so that it is flat against the underside of the top cover.



19. Close the top cover.
20. Close the tape access door.
21. Press and hold the lock buttons on both slides and slide the tape drive carefully into the rack.



22. While pressing the Density Select switch, press the Load/Rewind switch.

The Load indicator flashes while the tape loads and remains lit when loading is complete.

If the ARM FAULT DURING LOAD message is displayed, you did not wrap enough tape onto the take-up hub.

After threading the tape securely onto the take-up hub, press the Load/Rewind, Unload, or Test switches to reset the error.

WARNING: If either the top cover or front tape loading door are forced open, moving mechanical parts may cause injury.

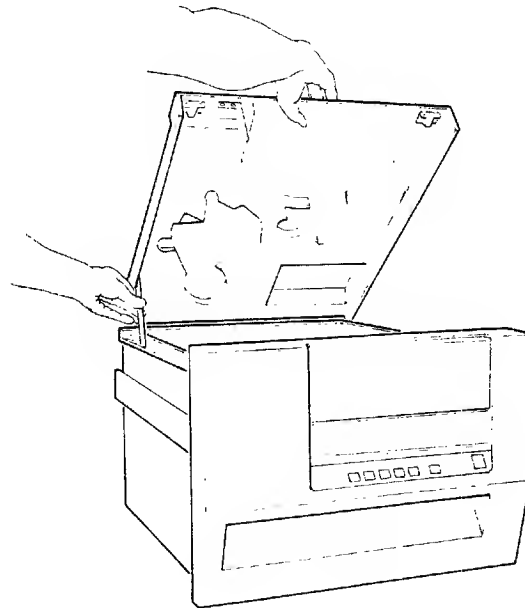
ACHTUNG: Wenn der Klappdeckel oder die vordere Bandladetüre mit Gewalt geöffnet werden, besteht Gefahr der Verletzung durch die beweglichen Teile.

6.3 Operator Maintenance

6.3.1 Cleaning the Tape Drive

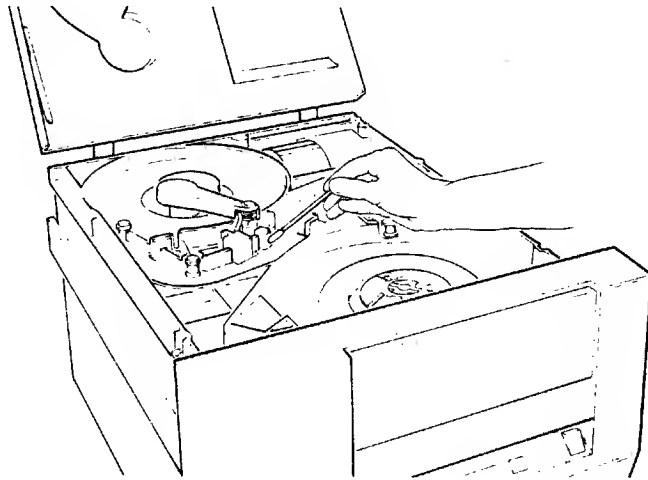
Use the following procedure after every eight hours of operation.

1. If the power is on, press the power switch to remove power from the tape drive.
2. Pull from behind the lower left-hand side of the front panel and slide the drive out of the rack.
3. Slide the drive forward until it is fully extended from the rack.
4. Grasp the lower edges of the top cover and lift.
5. While holding the top cover in the raised position, place the retainer bar in its slot next to the tape path.



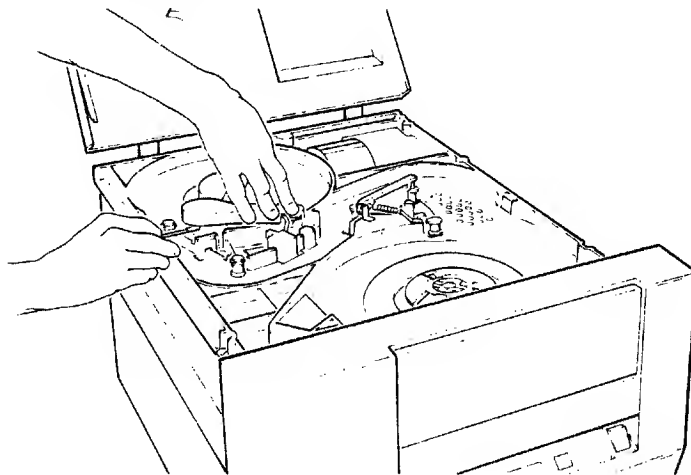
6. To clean the tape path, use the Cipher cleaning kit (Part 960855-001). Moisten a swab applicator with cleaner and carefully swab the surface of the read/write head and tape cleaner.

CAUTION: Rough or abrasive materials can scratch sensitive surfaces of the head resulting in permanent damage. Other cleaners, such as alcohol based types, can cause read/write errors or load failures. USE ONLY FREON TF (Trichlorotrifluoroethane).

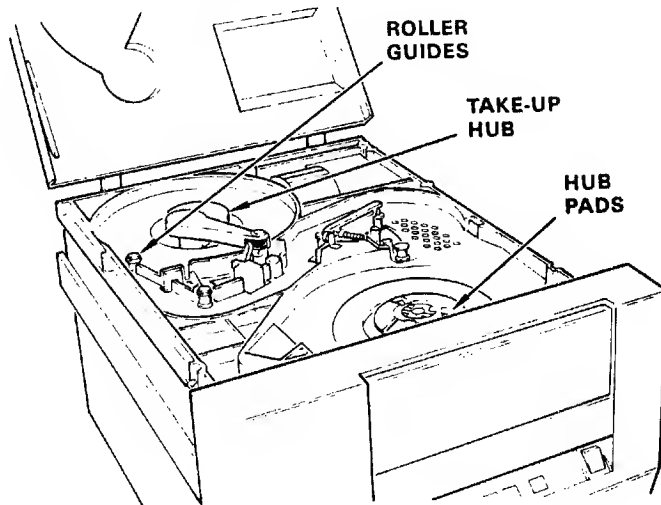


7. Clean the tachometer roller using the method described in step 6.

CAUTION: If the cleaning solvent seeps into the tachometer housing, it could damage the tachometer. Do not release the tachometer while holding it away from the take-up hub. It can be damaged if it strikes sharply against the hub.



8. Use the felt pads provided in the tape cleaning kit to clean the hub pads, takeup hub, and roller guides.



9. Lift the top cover until the retainer bar is clear of its slot.
10. While holding the top cover in the raised position, push the retainer bar back and up so that it is flat against the underside of the top cover.
11. Close the top cover.
12. Press and hold the lock buttons on both slides and slide the tape drive back into the rack.

6.3.2 Cleaning the Sensors

The EOT, BOT, and Tape in Path sensors should be cleaned every 40 hours using a dry, clean, cotton swab. Gently wipe any dust off the face of each LED lense, both the transmitter and receiver.

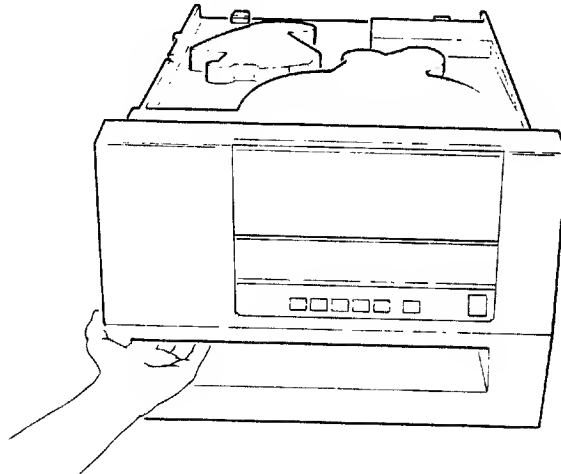
CAUTION: Wipe as gently as possible; the alignment of the LEDs is critical. Do not use any solvents to clean the LEDs; use only a dry swab.

6.3.3 Cleaning the Air Filter

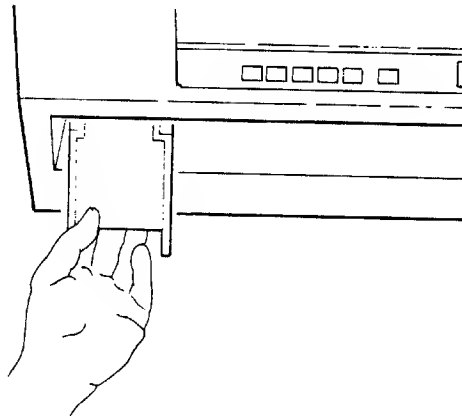
Use the following procedure every three months of operation.

1. If the power is on, press the power switch to remove power from the tape drive.

2. The filter is located just behind the rack latch at the lower left-side of the front panel. Feel for the filter tab and gently remove the filter.



3. Shake the filter clean.
4. Replace the filter.



CAUTION: This unit should be serviced by qualified maintenance personnel only.

ACHTUNG: Dieses Gerät darf nur von Fachpersonal gewartet werden.

6.4 Error Conditions

When the drive fails to operate properly, the indicators on the front panel of the unit flash patterns to alert the operator of an error condition. Error messages are also displayed by the alphanumeric display and describe the condition that must be corrected to allow normal operation. To reset soft or medium errors, press the flashing indicator switches on the front panel.

Three types of error conditions can be displayed:

1. Soft errors
2. Medium errors
3. Hard errors

Soft error messages are described in Section 6.1.3.

6.4.1 Medium Errors

Medium errors are usually caused by interface command or format violations. Medium errors are reported to the host system via the interface and usually require a restart command from the host. An error message is displayed on the alphanumeric display to aid in identifying the problem. The indicated problem must be corrected in order to continue operation. To reset the medium error, press the Load/Rewind and Unload indicator/switches on the front panel. Press the Load/Rewind switch again to restart the load sequence.

READ ONLY TAPE

If the READ ONLY TAPE message is displayed, the unit received a write command with a write protected reel of tape loaded on the transport. Install the write protect ring or load the proper tape on the unit and press the Load/Rewind or Unload switches to reset the error.

ILLEGAL COMMAND

If the ILLEGAL COMMAND message is displayed on the alphanumeric display, an illegal or undefined command was received by the unit. Press the Load/Rewind or Unload switches to reset the error. Receipt of a valid command will also reset the error.

WRITE RETRY EXCEEDED

If the WRITE RETRY EXCEEDED message is displayed, the unit exceeded the allowable number of write retries. Press the Load/Rewind or Unload switches to reset the error.

PAST EOT

If the PAST EOT message is displayed, tape travel beyond the EOT marker exceeded 18 feet. Once the controller error has been corrected, press the Load/Rewind or Unload switches to reset the error.

BLOCK SIZE ERROR

If the BLOCK SIZE ERROR message is displayed, the data block size exceeded the NOVRAM 64K value. Press the Load/Rewind or Unload switches to reset the error.

6.4.2 Hard Errors

Hard errors are caused by severely damaged tape, or a serious deviation from the normal operating routine of the M990. Since these malfunctions could cause damage to the tape, the transport drive servos are disabled and tape tension is removed in a controlled manner. Hard errors are reported to the host via the interface and an error message is displayed on the alphanumeric display. To reset the hard error, switch the unit power off and on, reload the tape, and issue a restart from the host system. The hard error messages are described below.

ARM FAULT DURING LOAD

If the ARM FAULT DURING LOAD message is displayed, the tension arm swing exceeded the range of normal operation during the auto-load sequence. After correcting the problem, switch the unit power off then on and issue a restart from the host system.

ARM FAULT DURING RUN

If the ARM FAULT DURING RUN message is displayed, the tension arm exceeded its free travel limits during any operation except those functions of the load and unload sequence when tape tension is not under arm control. After correcting the problem, switch the unit power off then on and issue a restart from the host system.

SPEED ERROR

If the SPEED ERROR message is displayed, tape speed variations in excess of the ANSI maximum of $\pm 10\%$ deviation from normal operating speed occurred.

TACH READ ERROR

If the TACH READ ERROR is displayed, a stable tachometer count could not be made. Since a record may have been erased while repositioning during a write operation, the tape should be rewound to BOT and the write operation repeated. A tape path that needs cleaning can cause this error.

6.5 Read Extended Status

Extended drive status is available to the host as four independently accessible records containing up to 16 bytes each. Extended status can only be read when the drive is ON-LINE. To access one of the 16-byte records, the host must first issue the Read Extended Status command, which is "00010" (EDIT). The command is accompanied by the usual IGO pulse. This command places the drive in the Extended Status Mode whereby the drive will wait for a second "ACCESS" command, accompanied by IGO. This second command, or Block Access Code, selects the appropriate 16-byte block to be transferred to the host as a normal read operation on the IR0-IR7 data lines, with read strobes. Should more than one record be desired, the Read Extended Status command/IGO pulse may be reissued and the appropriate block access code asserted on the five command lines, accompanied by the IGO pulse. The new status block is then strobed to the interface.

The Error History Block may be reset to zero if the block access code is "10011." A 16-byte block is still transferred, but the bytes have no meaning. A description of the information provided by the Read Extended Status command is given in Table 6-1.

Byte No.	Bit*	Contents
0	Tape Status Byte #1 0 IIDENT 1 IHER 2 ICER 3 IFMK 4 IRDY 5 IONL 6 IRWD 7 IFPT	
1	Tape Status Byte #2 0 ILDP 1 IEOT 2 Read Retries Exceeded 3 Write Parity Error At Interface 4 Write Hard Error 5 Illegal Command 6 7	
2	Error Classification 0 Cache Auto-Expanded 1 Block Size 2 3 Read From Tape To Cache Overrun 4 Write From Host To Cache Overrun 5 25 feet of blank tape detected 6 7	000 = 9K 001 = 16K 010 = 32K 011 = 64K 100 = Reserved
3	Track In Error 0 Track 7 In Error 1 Track 6 In Error 2 Track 5 In Error 3 Track 4 In Error 4 Track 3 In Error 5 Track 2 In Error 6 Track 1 In Error 7 Track 0 In Error	

* Bit 0 = LSB; Bit 7 = MSB, unless otherwise specified. (1 = True/Yes, 2 = False/No)

Current Status Block (Access Code = 00000)

Table 6-1. Read Extended Status

Byte No.	Bit*	Contents
4	0 1 Thru 7	Track P In Error LSB Read/Write Retry Count On MSB Current Host Record
5	0 Thru 4	LSB Front Panel Error Code MSB
6	0 1 2 3 4 5 6 7	Density Code Density Found/Operating Density (bpi): 000 = Reserved 001 = 1600 010 = 3200 011 = 6250 Density Requested: 000 = Reserved 001 = 1600 010 = 3200 011 = 6250 6 Read Density Conflict 7 Write Density Conflict
7	0 Thru 7	Unfixed Block Count (includes file marks) Block Detectable Structures Remaining In Cache Fixed Block Count From BOT (includes file marks)
8 9 10		Low Order Byte Mid Order Byte High Order Byte Sequence Number Of Record In Hard Error
11 12 13		Low Order Byte Mid Order Byte High Order Byte

Current Status Block (Access Code = 00000)

Table 6-1. Read Extended Status (Continued)

Byte No.	Bit*	Contents
0	Capability 0 Reserved 1 1600 bpi 2 3200 bpi 3 6250 bpi 4 Other	0 = Does not have capability 1 = Does have capability
1	Vendor Code	
2	Model Code 0 000 = Other 1 001 = Reserved 2 010 = Reserved Thru 7	011 = Reserved 100 = Reserved 101 = Reserved 110 = M990 111 = Reserved
3	Configuration State 0 EOT Location-- 1 Parity-- 2 Max. Block 3 Size 4 Ramp-- 5 Simulated Speed Setting (LSB) 6 Simulated Speed Setting 7 Simulated Speed Setting (MSB)	1 = EOT Search, 1 = External, 00 = 9K 01 = 16K 1 = Disabled, 0 = STD. 0 = Internal 10 = 32K 11 = 64K 0 = Enabled
4	Software Configuration 0 1 2 3 EOT and Double Filemark Streaming Option 4 3200 BPI IIDENT Status Option 5 6 7	

Configuration Status Block (Access Code = 10000)

Table 6-1. Read Extended Status (Continued)

Byte No.	Bit*	Contents
0		Read Retry Count - Since Unload (255 max)
1		Write Retry Count - Since Unload (255 max)
2		Track History - Error Counts Per Track (255 max)
3		Track 0
4		Track 1
5		Track 2
6		Track 3
7		Track 4
8		Track 5
9		Track 6
10		Track 7
		Track P

Error History Block (Access Code = 00010)

Byte No.	Bit*	Contents
		Head Position/Tach Count In Multiples Of 1.28 Inches
0		Low Order Byte Of Tach Count
1		High Order Byte Of Tach Count
		Logical Command History
2		Previous Host Command
3		2nd Previous Host Command
4		3rd Previous Host Command
5		4th Previous Host Command
6		5th Previous Host Command
7		Operating Status
	0	Reel Size (LSB) 00 = Unknown 01 = 7 Inch
	1	Reel Size (MSB) 10 = 8-1/2 Inch 11 = 10-1/2 Inch
	2	Door Lock Status: 0 = Unlocked 1 = Locked
8	(LSB)	Tachometer reading indicating BOT location
9	(MSB)	
10	(LSB)	Tachometer position at impending EOT
11	(MSB)	

Machine Status Block (Access Code = 10010)

Table 6-1. Read Extended Status (Continued)

GLOSSARY

CHAPTER 7

SIGNAL PWB	DESCRIPTION
f+ SERVO	Switching frequency + to pulse-width modulator 20 Khz sawtooth.
f- SERVO	Switching frequency - to pulse-width modulator 20 Khz sawtooth.
+12V SERVO	Used for IC operation.
+15V SERVO	Used for IC operation.
+57V SERVO	Input from power supply for operation.
+5V SERVO	Used for TTL logic circuits.
+6V SERVO	Used for IC operation.
-12V SERVO	Used for IC operation.
-15UR SERVO	Used for IC operation.
-6V SERVO	Used for IC operation.
10.85MHZ CLK CPU	Crystal frequency.
159 CLK CIF	Character clock pulse - one for each character received.
158 TC CIF	Terminal count equals 158 characters.

1600 PE CPU	Write mode, 1600 BPI.
2.71MHZ CLK CPU	Boot frequency.
5.43MHZ CLK CPU	CIO frequency.
6250 SERVO	GCR mode selected.
6250 WRT SERVO	6250 write mode selected. Changes head current.
A SERVO	Multiplexer code select A/D.
A0-A11 CPU	Channel clock (DMA).
A0-A7 CPU	DRAM address bus.
A0-A11 CIF	Write state machine input.
A0A-A7A CPU	Low order cache memory address bus.
A0B-A7B CPU	High order cache memory address bus.
ABUF CPU	DMA 'A' buffer clock.
AD0-AD15 CPU	Address/data bus.
ADC IN SERVO	Analog to digital IC select.
ADRSEL SERVO	Address switch from OCP.
ADV/H* CIF	Advance/hold DMA address logical drive.
ADV/HEN* CIF	Enable ADV/H* logic.
AFBY CIF	Formatter busy output gate enable.

AL12-AL15 SERVO	Latched address line, decoded for servo PWB control.
AMUX CPU	Dynamic RAM address multiplexer switch.
ARMCLK SERVO	20Khz compliance arm clock.
ARMDIV CIF	Compliance arm rate of change.
ARMPOS SERVO	Compliance arm position.
ARMSNS SERVO	Air capacitor output.
AS CPU	Address strobe. Rising edge indicates address on bus valid.
A to D CLK SERVO	333Khz for A/D converter.
B SERVO	Multiplexer input code BIT A/D converter.
B CLK CPU	Channel clock.
B/W CPU	Byte/word - 8 or 16 bits on Z8000 address/data bus.
B0-B1 DATA	Control inputs to master state machine.
BAD0-BAD15 CPU	Buffered address/data.
BAD0-BAD5 SERVO	Alpha display bits, front panel.
BBUF CPU	DMA 'B' buffer clock.
BDS SERVO	Alpha display strobe.
BLOCKDET DATA	Distinguishes between erased tape and recorded tape.
BLWR SERVO	Turn on blower motor.

BLWR* SERVO	Blower control from Z8000.
BLWRR SERVO	Blower relay return.
BOOT CPU	Set on Power-up Reset to allow 1/2 speed clock.
BOOTRD CPU	Enable EPROMS for boot readout.
BOT SERVO	Beginning of tape sense.
BR/W* CPU	Buffered R/W Z8000 line.
BRD0-BRDF CIF	Buffered cache read data.
BRDATA0-BRDATA DATA	Input to data bus.
BRWLB CIF	Buffered R/W last byte.
BUF DWN DATA	Disables master state machine during power-up.
C SERVO	Multiplexer input code to A/D converter.
C CLK CPU	Channel clock.
C REFRESH CPU	Refresh cache address.
C0-C2 CIF	Write state machine outputs to data encoder.
CA0-CA2 CIF	Data character count, syncs DMA cache with formatter.
CACRC CIF	Clear auxiliary CRC.
CADD CPU	Select cache address.
CAS0-CAS# CPU	Memory address strobes for cache.

CASH CPU	Memory address strobe for high DRAM.
CASL CIF	Memory address strobe for low DRAM.
CBUF CPU	DMA 'C' buffer clock.
CC1-CC5 CIF	Data rate control bits.
CCR CIF	CPU data clock.
CCRC CIF	CRC clock.
CDATA CPU	Select cache data.
CER CIF	Corrected data error.
CHO-CH P CIF	Write data to head.
CHCLEAR DATA	Clear channel state machine.
CHERR0-CHERR P DATA	Channel drop detected.
CHRDY0-CHRDY P DATA	Deskew circuit has data in it.
CK/I CIF	Check or input parity.
CLK CIF	Clock to write data encoders.
CLK271 DATA	2.7Mhz clock.
CLK2X CIF	2 times 1600 bpi clock rate.
CLK542 DATA	5.4Mhz clock.
CLKX CIF	1600 bpi clock rate.

CN CPU	Carry-in bit to MMU.
CNT14 CIF	Reduced rate counter output.
CNT15 CIF	Reduced rate counter output.
COMV/SHIFT* CIF	GCR control signal.
CPU ADV CPU	Gate Z8000 data to cache bus.
CPU C READ CPU	Output CPU cache address.
CPU DOWN CPU	Decrement CPU cache address.
CPU LOAD CPU	Load CPU cache address.
CPU+4 CPU	Carry-out bit from MMU.
CPUCLK CPU	CPU DMA cycle.
CRSTR CIF	CIF read strobe.
CZDS CPU	Data strobe to cache.
DAC SERVO	Digital to analog IC select.
DATA+STACK CPU	Select data portion of DRAM.
DATA/CONT* CIF	Control term from write state machine.
DBY CIF	Data busy.
DDIS CIF	Data DMA strobe.
DIS CIF	Data interface strobe.

DMA0-DMA17 CPU	Input address to MMU.
DMP D0-DP CPU	Input to cache memory.
DPPE CIF	CIF logic data path parity error.
DR SERVO	Door sense.
DRAM R/W* CPU	Read/write control to DRAM.
DRDY DATA	Data in FIFO registers.
DRLK SERVO	Door lock solenoid driver.
DS CPU	Data strobe.
DS1-DS5 SERVO	Front panel (OCP) LEDs.
DSPSL SERVO	Display select.
DT CIF	Data transmission, start the state machine.
EDIT CIF	Edit command bit.
EH1 SERVO	Erase head.
EH1EN SERVO	Erase head 1 enable.
EH1R SERVO	Erase head return.
EH2EN SERVO	Erase head 2 enable.
EH2R SERVO	Erase head return.
EMK0-EMKP DATA	End of GCR data detected.

EMK1PE0 DATA	End mark or PE all zeros detected.
EN2 SERVO	Erase head.
ENA CPU	Enable CPU bus and DMA 0-15.
ENAX CPU	Enable DMA bus.
ENDATA DATA	Enable clock to gate data to bus.
ENFIFO DATA	Enable FIFO clock.
ENMASTER DATA	Enable master state machine
EOT SERVO	End of tape sensed.
ER1 CIF	Erase head.
FAD1-FAD3 CIF	Formatter address.
FB1-FB4 CIF	State machine control feedback.
FBOE1 CIF	State machine feedback enable/clear.
FEN CIF	Formatter enabled.
FGCR CIF	CDC status line indicating GCR mode.
FHMPE CPU	Force high memory parity error.
FIFO CLK DATA	Clock to FIFO register.
FLGAP CIF	Long gap instruction (N.U.).
FLMPE CPU	Force low memory parity error.

FLOL CIF	Not used.
FMK CIF	File mark detected.
FP/RSS SERVO	File protect/reel seat sensor.
FPT SERVO	File protect sensed.
FRC1-FRC4 CIF	PE carrier control.
FSEL CIF	Formatter selected.
FWD SERVO	Control to reel motor drivers.
FWD/REV DATA	Indicates direction of tape.
G0 CIF	Command strobe.
G1 CIF	Gate timing.
G2 CIF	Gate timing.
G4 CIF	Gate timing.
GCR/PE* DATA	Recording mode selection.
GN CIF	Enable pad and CRC gate.
GPAD CIF	Gate pad character to data bus.
GRESID CIF	Gate residual counter to data bus.
HBANK SERVO	MSB DRAM address.
HBLK SERVO	Hub lock solenoid driver.

HER CIF	Uncorrectable error.
HI I* SERVO	HI current detected one shot. Used mostly during start-up.
HIDEN SERVO	High density push button/LED.
HISP CIF	High speed command bit.
I/CK* CIF	Input or check parity.
I/O CPU	Input or output operation to CPU bus.
I2/4 CPU	MMU instruction bit.
I3 CPU	MMU instruction bit.
IACRC CIF	Increment ACRC.
IBLE CIF	Interface logic board enable.
ICER CIF	Indicates a correctable error has occurred during write or read operation.
ICR CIF	Cache interface clock.
ICRC CIF	Increment CRC.
IDBY CIF	Data busy, true during commands initiated by IGO.
IDENT CIF	PE ID burst detected.
IECC CIF	Increment ECC.
IEDIT CIF	Host command line.
IEI CPU	Interrupt enable in, sets interrupt priority.

IEO CPU	Interrupt enable out, sets interrupt priority.
IEOT CIF	Tape is located past the end of tape marker.
IERASE CIF	Host command line.
IES CIF	Interface early strobe.
IESUB CPU	Interface early strobe buffer.
IFAD CIF	Formatter address bit.
IFBY CIF	Formatter busy, tape motion.
IFCREAD CPU	Output logical tape address.
IFDOWN CPU	Decrement logical tape address.
IFEN CIF	Formatter enable.
IFLOAD CPU	Load logical tape address.
IFMK CIF	Pulsed to indicate a file mark has been detected.
IFPT CIF	File protect, reel does not have a write-protect ring.
IFO CIF	Latches command from host to tape drive. Minimum 1us pulse.
IHER CIF	Record being written or read contains an uncorrectable error (Hard).
IHISP CIF	High speed mode line from the controller.
IIDENT CIF	PE identification burst detected at load point.
ILDP CIF	Tape is located at load point (BOT).

ILW CIF	Write last word.
ILWD CIF	Last word terminates a write or variable length erase operation.
INFACE EARLY ST CPU	Interface early strobe.
INTO-INT5 CPU	Interrupt priority selection.
INTA CPU	Acknowledge interrupt from CIO.
INTACK CPU	Acknowledge interrupt.
INTERFACE ADV CIF	Advance cache memory address.
INTERFACE CLK CPU	Logical tape drive DMA cycle.
IO CPU	IO operation.
IONL CIF	Tape drive is on-line to host.
IORD CPU	IO read data strobe.
IOW1 CIF	Latch interface output word 1.
IOW2 CIF	Latch interface output word 2.
IOW3 CIF	Latch interface output word 3.
IOWR CPU	IO write data strobe.
IR0-IR P CIF	Read data to host.
IRDY CIF	Ready, tape tensioned, not rewinding, loading, or unloading.
IREV CIF	Initiates a rewind command minimum 1us pulse.

IREWU CIF	Rewind to load point and unload tape.
IRST CIF	Interface reset or stopped.
ISTR CIF	Read data strobe, pulsed with each character - drive to host.
IRWD CIF	Tape drive is busy rewinding.
ISPEED CIF	Speed status.
ISU SERVO	Supply motor drive current.
ITAD0-ITAD1 CIF	Used for tape drive address.
ITC CIF	Read last word.
ITHR SERVO	Read threshold voltage.
ITU SERVO	Take-up motor drive current.
IW0-IW P CIF	Host write data.
IWFM CIF	Host write file mark command.
IWRT CIF	Host write command.
IWSTR CIF	Write strobe, pulsed with each character sent from host.
LA0-LA15 CPU	Latched address bits.
LDP CIF	Load point.
LEDSEL SERVO	LED select.
LLWD CIF	Read or write last word.

LOAD SERVO	Load push button/LED.
M321-M325 CIF	Module 32 counter.
MA0-MA2 CPU	Byte sync between cache and data bus.
MAD AB SERVO	Analog to digital multiplexer select.
MDAC SERVO	Digital to analog multiplexer select.
MK2/PE1 DATA	Mark 2 or PE all ones detected.
MK2/PEPO-MK2/PE DATA	Mark 2 or postamble detected.
MRD0-MRD P CPU	Cache read data bus.
MREQ CPU	Memory request, address/data bus holds an address.
MWD0-MUD P CPU	Cache write data bus.
N CIF	Control decision to pad or not to pad CRC.
NMI CPU	Non-maskable interrupt.
OACRC CIF	Output of Aux CRC character to data bus.
OCRC CIF	Output CRC character to data bus.
OECC CIF	Out put ECC character to data bus.
ONL CIF	On-line status.
ON-LINE SERVO	On-line push button/LED.
OVERFLOW DATA	Deskew buffer full.

P/G* SERVO	Recording mode PE or GCR.
PADCNT DATA	Pads eighth character during PE read into cache.
PC CIF	Positive cycle of the CPU clock.
PCHECK CPU	Cache memory parity error.
PCHECK CLK CPU	Check cache parity.
PE/GCR DATA	Recording mode selection.
PEPAD DATA	PE preamble detected.
PFB1-PFB4 CIF	State machine control feedback.
PI CIF	Positive cycle of interface clock.
PLL RESET DATA	Reset phase lock loop.
POSTAM DATA	Postamble detected.
PROCINT DATA	Processor interrupt.
PRW CIF	Positive cycle of read/write clock.
PWR RES SERVO	Power reset (10ms).
Q0-Q P CPU	Cache memory data output.
QMP CPU	Cache memory parity bit.
R BOOT CPU	Reset boot latch.
R/W CPU	Read or write.

R/W BC CPU	Read/write byte clock.
R/W C READ CPU	Output physical tape cache address.
R/W DOWN CPU	Decrement physical tape cache address.
R/W L BUB CPU	Read or write last byte.
R/W LOAD CPU	Load physical tape to a physical address.
R/W* CIF	Transport read/write mode.
RAM DS CPU	RAM data strobe.
RAS CPU	RAM address row select.
RAS0-RAS3 CPU	Address strobe cache row address.
RCRCS CIF	Reset CRC and ACRC.
RD C DATA CPU	Gate cache data to Z8000 bus.
RD0-RD P CIF	Read data bus.
RDATA0-RDATAP DATA	Skew check data output.
RDC BIT0-BIT P DATA	Read data clock.
RDPLS0-RDPLS P DATA	Pulse for each transition from tape.
RDROP0-RDPLS P DATA	Loss of read data in channel.
RDT CIF	Reset data transmission latch (DT).
RDY CIF	Ready, not rewinding or loading.

READ ADV DATA	Advance MMU address.
READ CAS CPU	Enable column address to read from cache.
RECALL NR CPU	Recall NOVRAM.
RECC CIF	Reset ECC.
RECEIVE SERVO	Serial port receive signal.
REFRESH CPU	Selects low byte of DRAM.
RESET CPU	
RESET CIF	
RESET SERVO	
RESET DATA	
REV CIF	Motion direction command bit.
REVEN CIF	Read data parity even.
REVERSE BANKS CPU	Reverse control and data portion of DRAM.
RFBYP CIF	Reset formatter busy.
RLGP CIF	Reset long gap.
RLY EN SERVO	Enable motor shorting relay K1.
RPH CPU	RAM parity high byte.
RPL CPU	RAM parity low byte.

RSTP CIF	Reset interface logic.
RSTREN CIF	CIF read strobe enable.
RTEST CIF	Test mode, Z8000 directs output to read data latches.
RWCR CIF	Cache physical drive clock.
RWD CIF	Rewind latched.
RWLB DATA	Read or write last byte.
RWSEN CIF	Enable read strobe during WRT.
SCIO CPU	Select CIO.
SCLK SERVO	20Khz clock to serial port controller.
SD BIT0-BIT P DATA	Separated data.
SDTP CIF	Start data transmission.
SEL 2P CIF	Latch on-line status to Cipher interface.
SEL 3P CIF	Latch rewind status to Cipher interface.
SEL 8F CIF	Reset on-line status to Cipher interface.
SEL 9P CIF	Reset rewind status to Cipher interface.
SERVCLK SERVO	40Khz servo clock for motors.
SERVEN1 SERVO	Servo enable SU.
SERVEN2 SERVO	Servo enable TU.

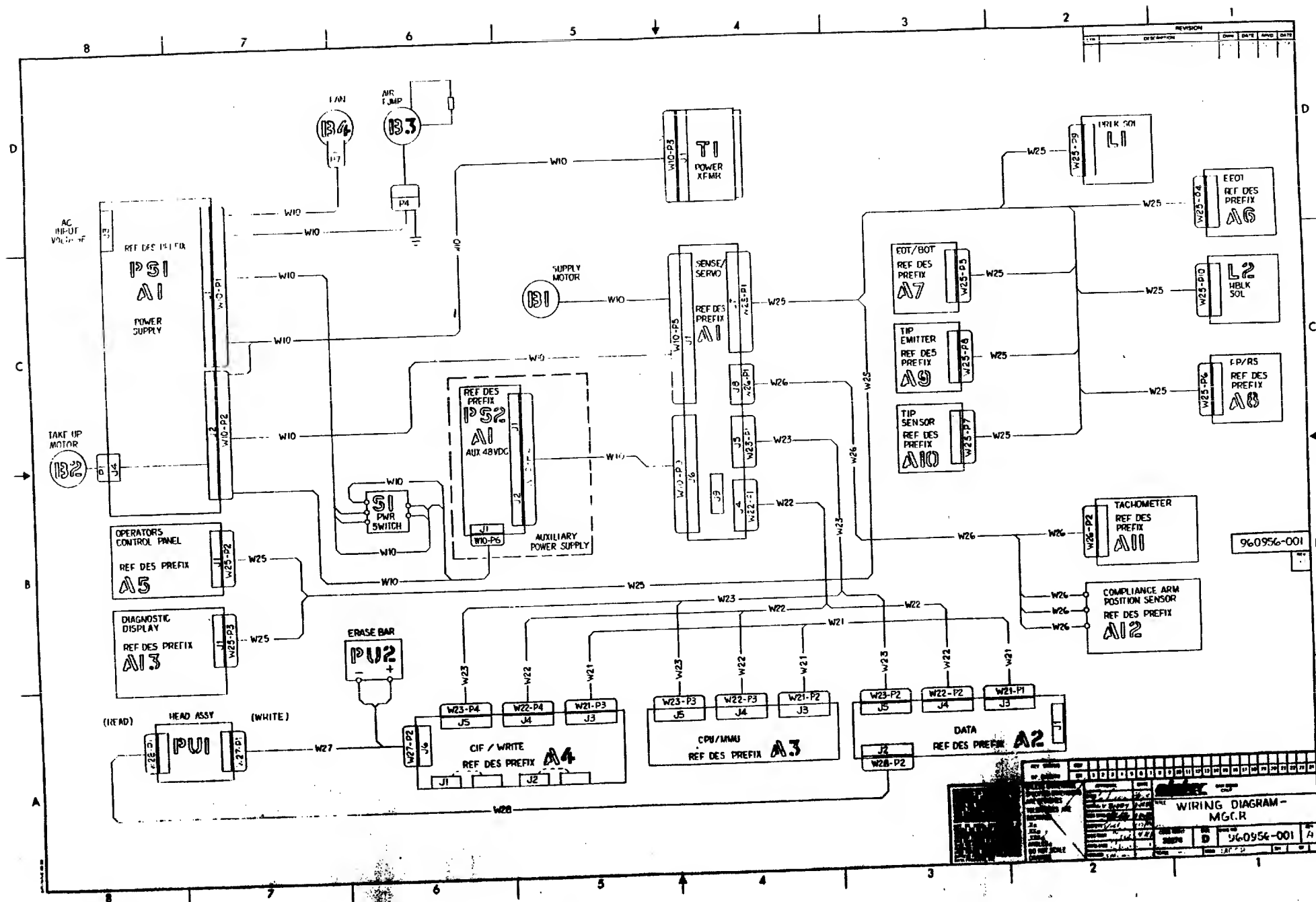
SMCLK CIF	State machine clock determines data interface transfer rates.
SMI SERVO	Supply motor current.
SMOE2 CIF	State machine enable.
SMRST CIF	State machine reset.
SMV SERVO	Supply motor voltage.
SPECIAL IO CPU	Memory addressing mode.
SRDATAO-SRDATA DATA	Serial read data.
STACK CPU	Memory addressing mode.
B,C STCKL A DATA	Master state machine clocks.
STEPEN 0 CIF	Write driver current step enable.
STEPEN 1 CIF	Write driver current step enable.
STORE NR CPU	Store NOVRAM.
SUD SERVO	Supply motor drive.
SUDR SERVO	Supply motor drive return.
SUPPLY FWD SERVO	Forward command to H bridge.
SUPPLY REV SERVO	Reverse command to H bridge.
SYSCLK CPU	5.4Mhz clock.
TAKE-UP FWD SERVO	Forward motion to H bridge.

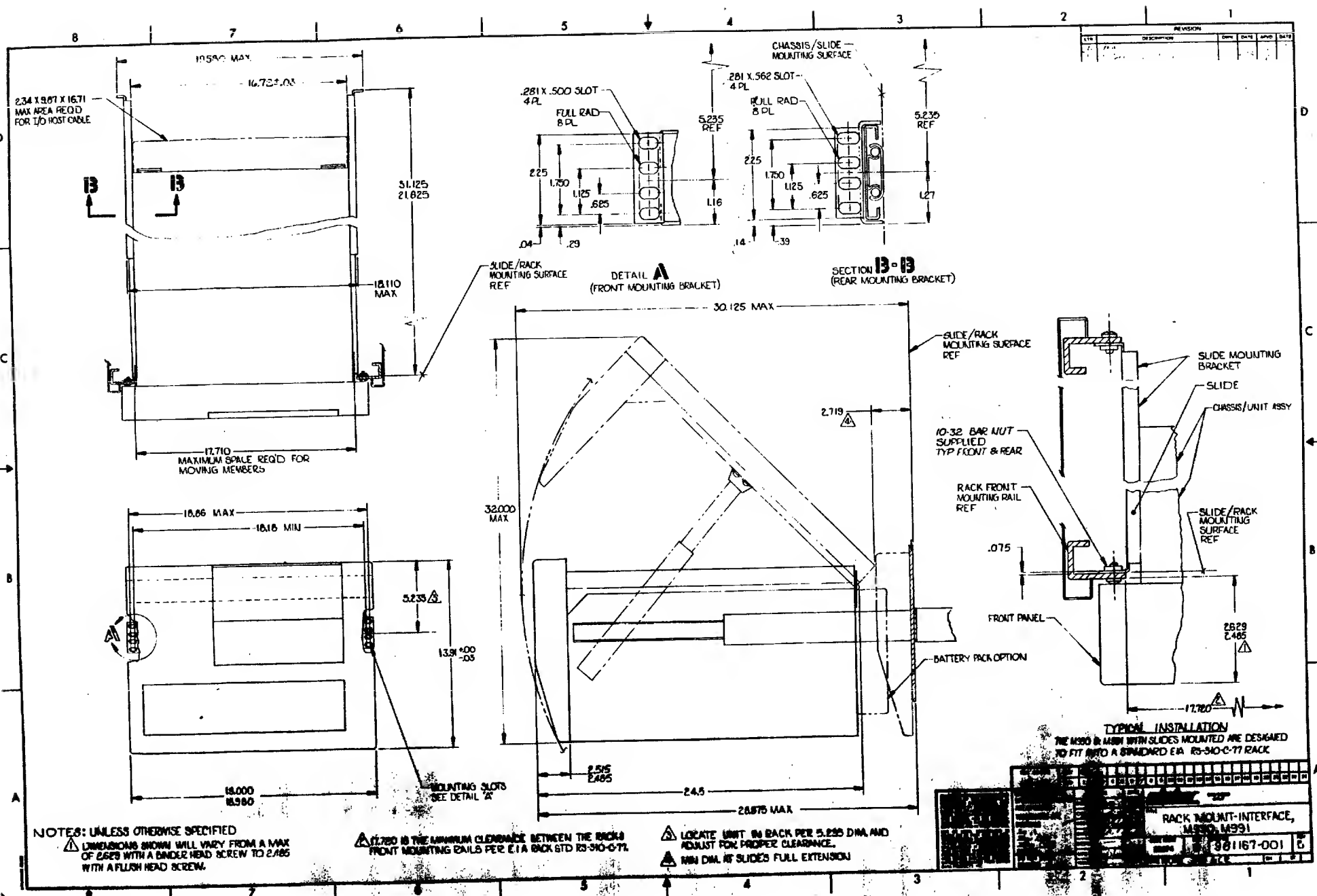
TAKE-UP REV SERVO	Reverse command to H bridge.
TDREQ CIF	Test mode request.
TERMCNT/TEST DATA	Read termination count or test.
TIP SERVO	Tape in path sensed.
TMI SERVO	Take up motor current.
TMV SERVO	Take up motor voltage.
TP0 SERVO	Tachometer phase 2.
TP1 SERVO	Tachometer phase 1.
TRANSMIT SERVO	Serial port transmit signal
TRAP CIF	CIF state machine error.
TUD SERVO	Take up motor drive.
TUDR SERVO	Take up motor drive return.
UNLOAD SERVO	Unload push button/LED.
VCERR DATA	Vertical parity error.
VCOM DATA	Read threshold voltage.
VI CPU	Vectored interrupt.
VREF SERVO	Reference voltage (+5V).
VREF ADJ SERVO	Monitor point for adjustment of VREF.

WAIT CPU	Memory of IO device is not ready for data transfer.
WATCHDOG ENABLE CPU	Enable watchdog circuit.
WCL0 CIF	Write clock to write driver.
WCL1 CIF	Write clock to write driver.
WCL2 CIF	Write clock to write driver.
WCLR CIF	Clear write drivers.
WCTV SERVO	Write voltage center tap.
WDATA0-WDATA P CIF	Write data to head drivers.
WDOGEBA UB CPU	Resets watchdog if a DRAM parity error is detected.
WE0-WE3 CPU	Write control to cache memory.
WEN SERVO	Write mode selected.
WEVEN CIF	Write parity is even.
WFB3 CIF	PE/GCR* phase encode/not GCR mode.
WFBO-WFB2 CIF	Write formatter state machine control bits.
WFLC CIF	Write formatter state machine load command.
WFM CIF	Write file mark command bit.
WFWA CIF	Write formatter write advance.
WIP CIF	Write data latch output enable.

WLOE CIF	Write data latch output enable.
WR TACH SERVO	Tach pulse.
WRC ADDL CPU	Clock cache ADDR to MMU.
WRITE ADV CIF	Advance cache address.
WRITE CAS CPU	Enable address column to write to cache.
WRITE OP DATA	Write operation in progress.
WRT CIF	Write command bit.
WRTEN/TEST SERVO	Push button/LED front panel.
WSTR CIF	Interface write strobe.
WSTREN CIF	Enable CIF write strobe.
WTEST CIF	Test mode, Z8000 directs output to write data latches.
Y0-Y17 CPU	Cache address output bits from MMU.
Z2C1 SERVO	Watchdog refresh clock (10Mhz).
ZAD0-ZAD15 CPU	Z8002 address/data lines.
ZAS CPU	Z8002 address strobe.
ZCLK CPU	5.4Mhz clock to Z8002.
ZDS CPU	Z8002 data strobe.
ZI/O CPU	Z8002 IO operation.

ZIORD CPU	IO read data strobe.
ZIOWR CPU	IO write data strobe.
ZMREQ CPU	Memory request. Low indicates A/D lines contain an address.
ZR/W* CPU	Indicates CPU is reading from or writing to memory or I/O.

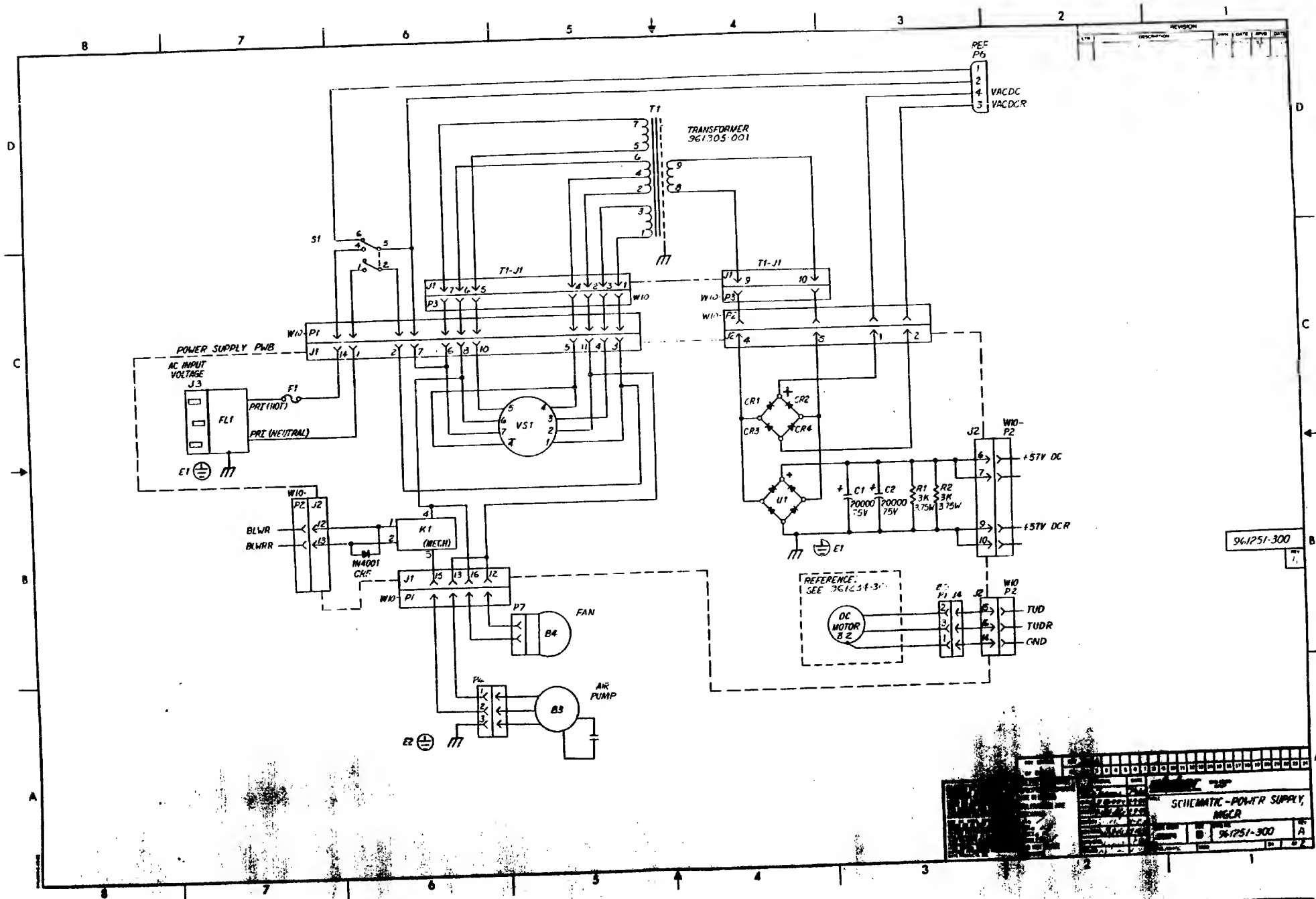


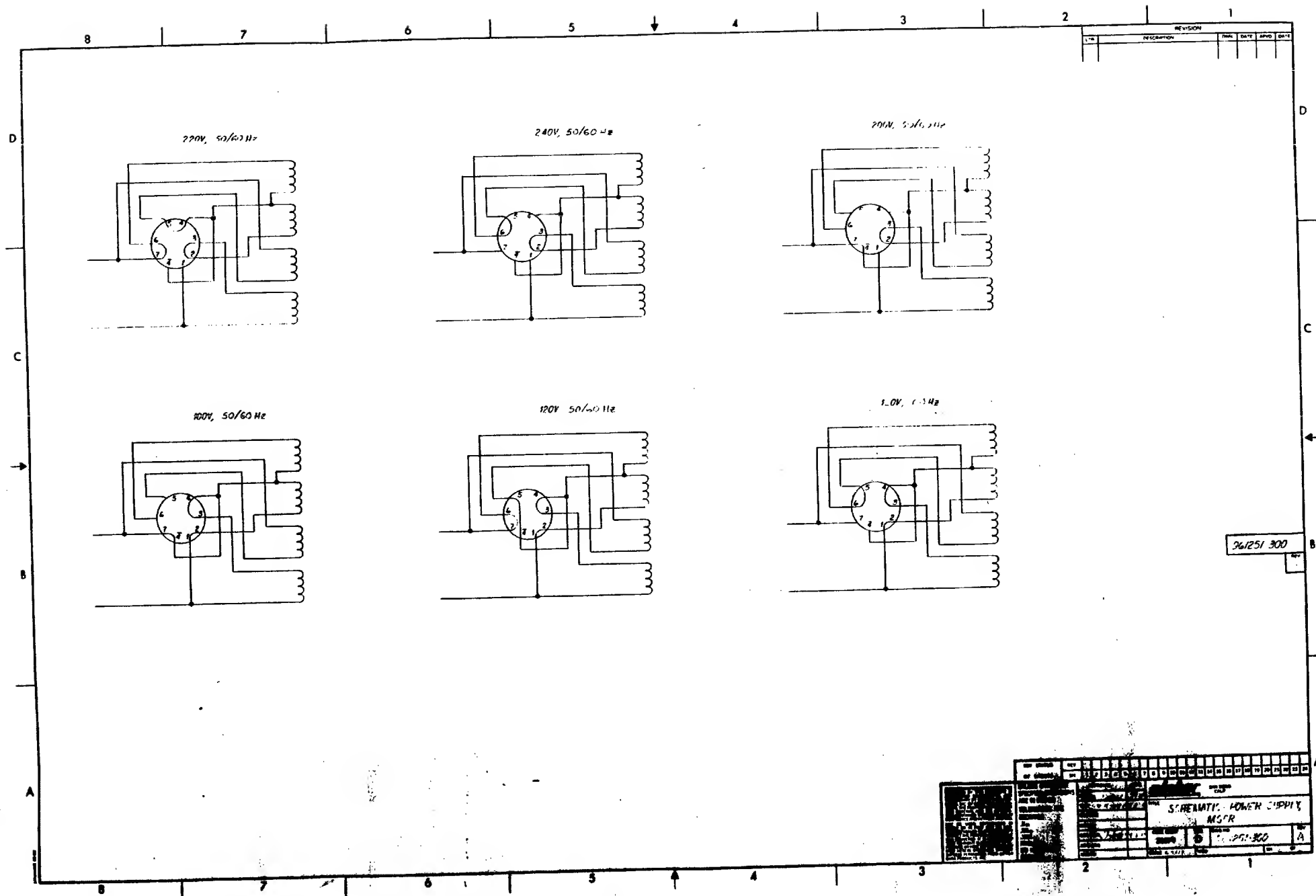


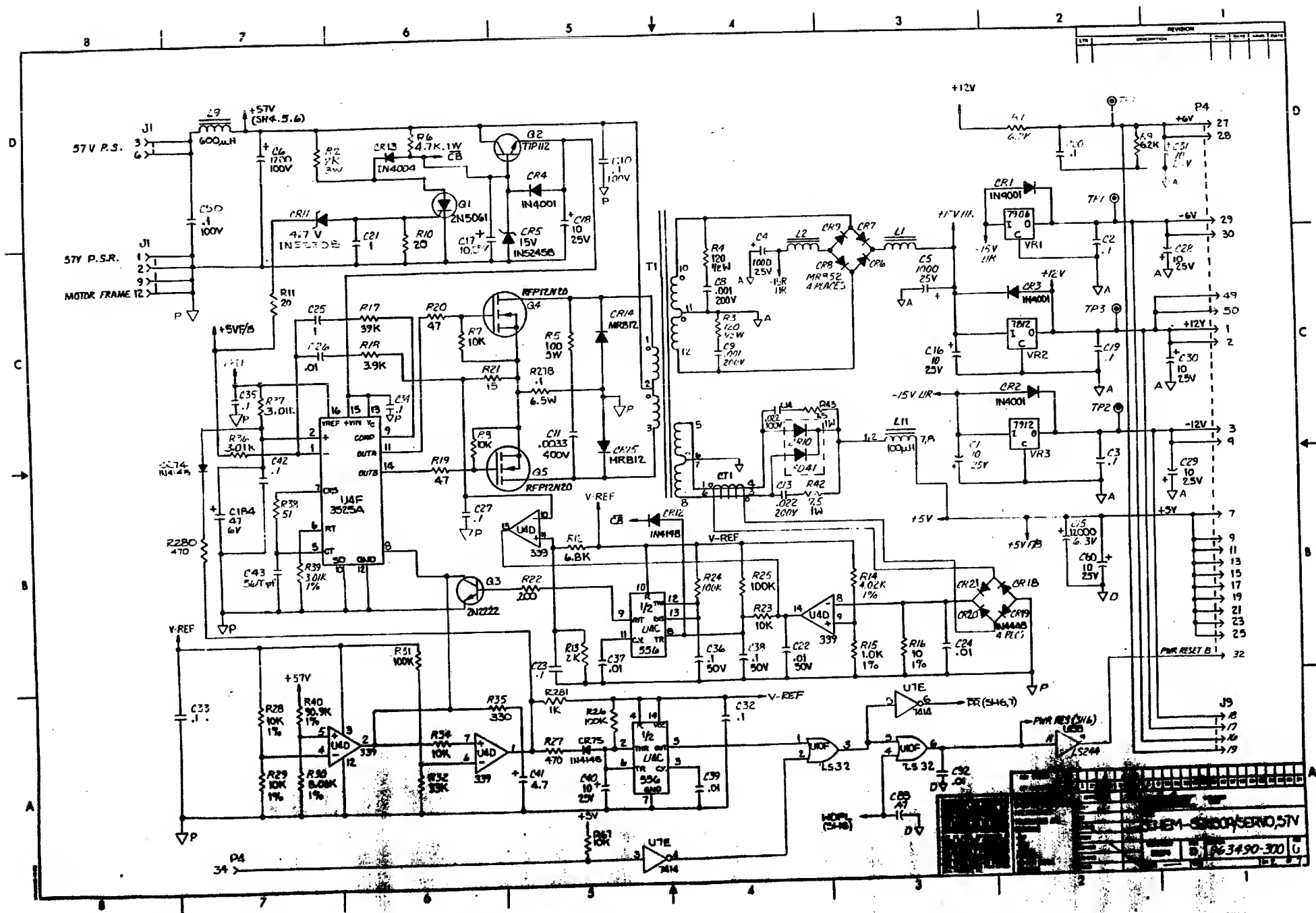
NOTES: UNLESS OTHERWISE SPECIFIED
 △ DIMENSIONS SHOWN WILL VARY FROM A MAX
 OF .0625 WITH A BINDER HEAD SCREW TO .2485
 WITH A FLUSH HEAD SCREW.

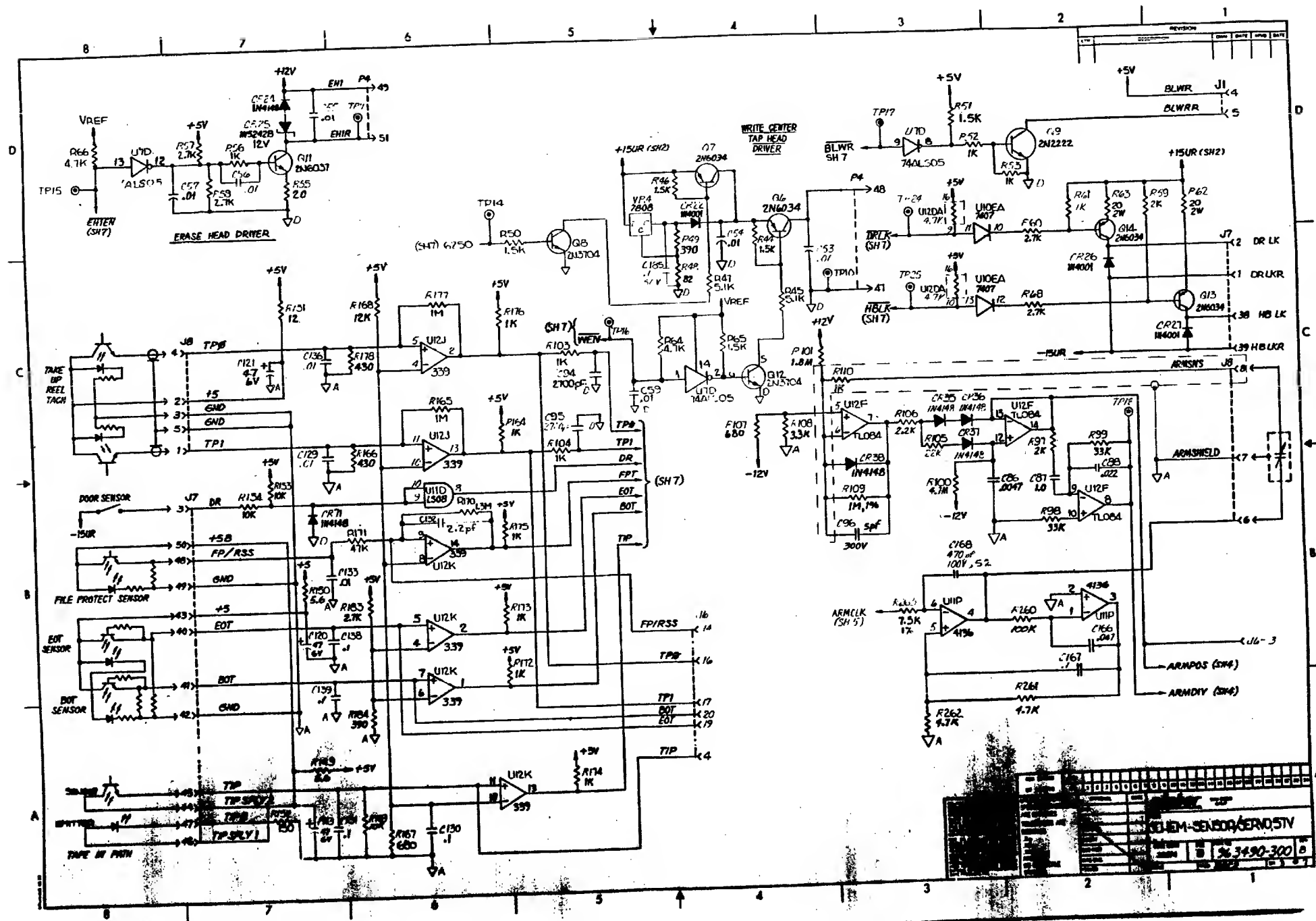
△ 17.720 IS THE MINIMUM CLEARANCE BETWEEN THE RACK'S
 FRONT MOUNTING RAILS PER EIA RACK STD RS-310-C-77.

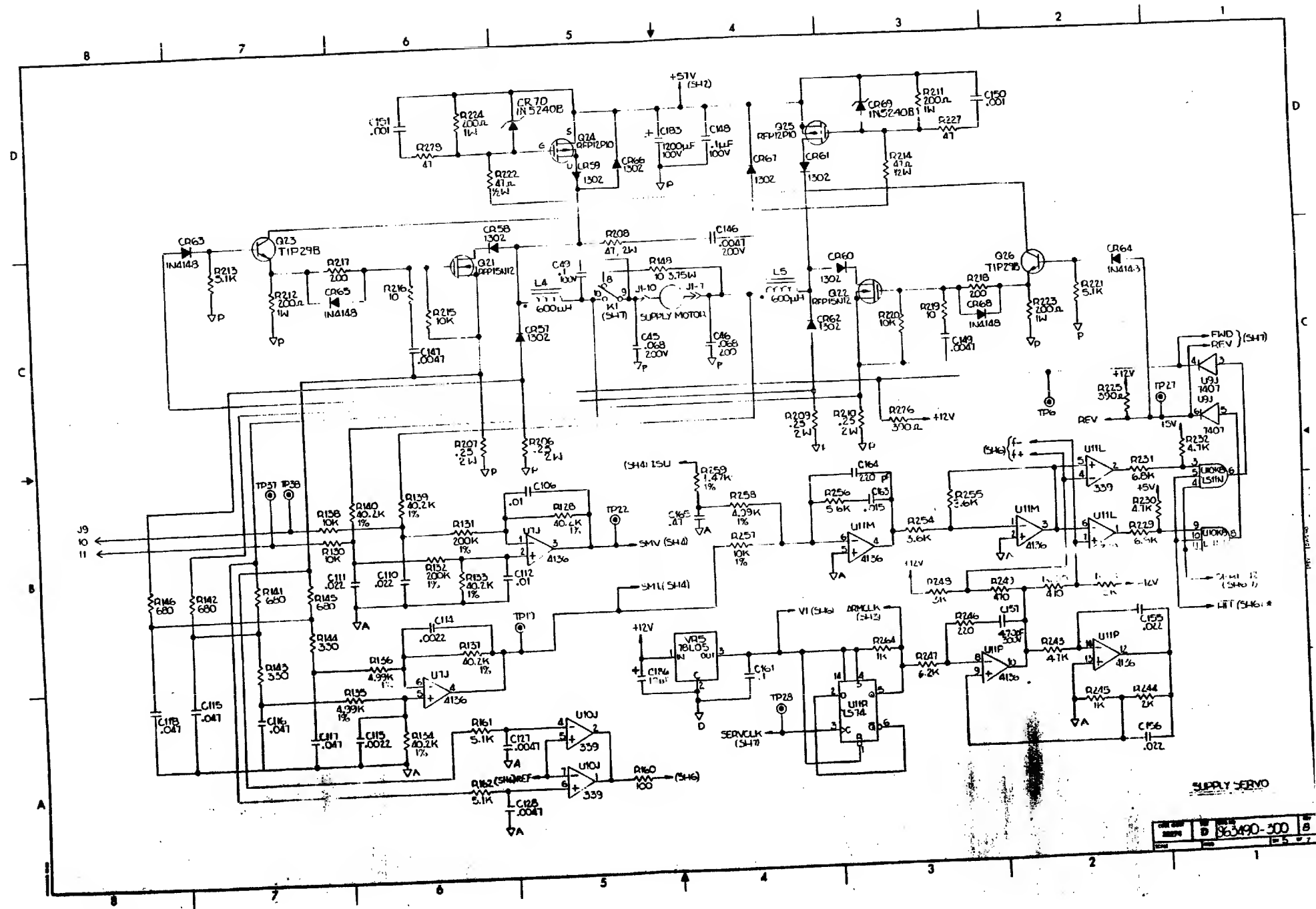
△ LOCATE UNIT IN BACK PER 5.525 DIA AND
 ADJUST FOR PROPER CLEARANCE.
 △ MIN DIA AT SLIDES FULL EXTENSION

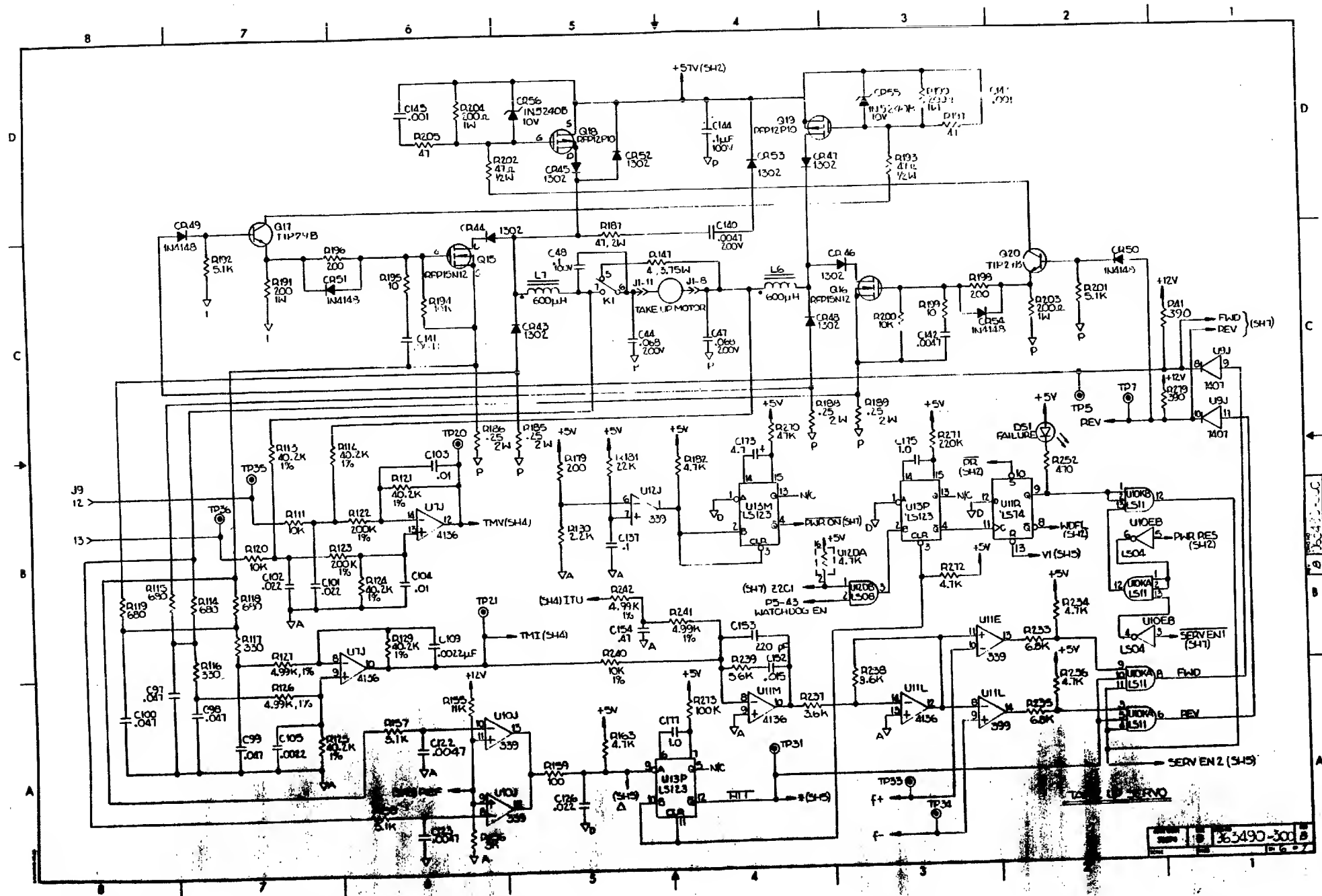


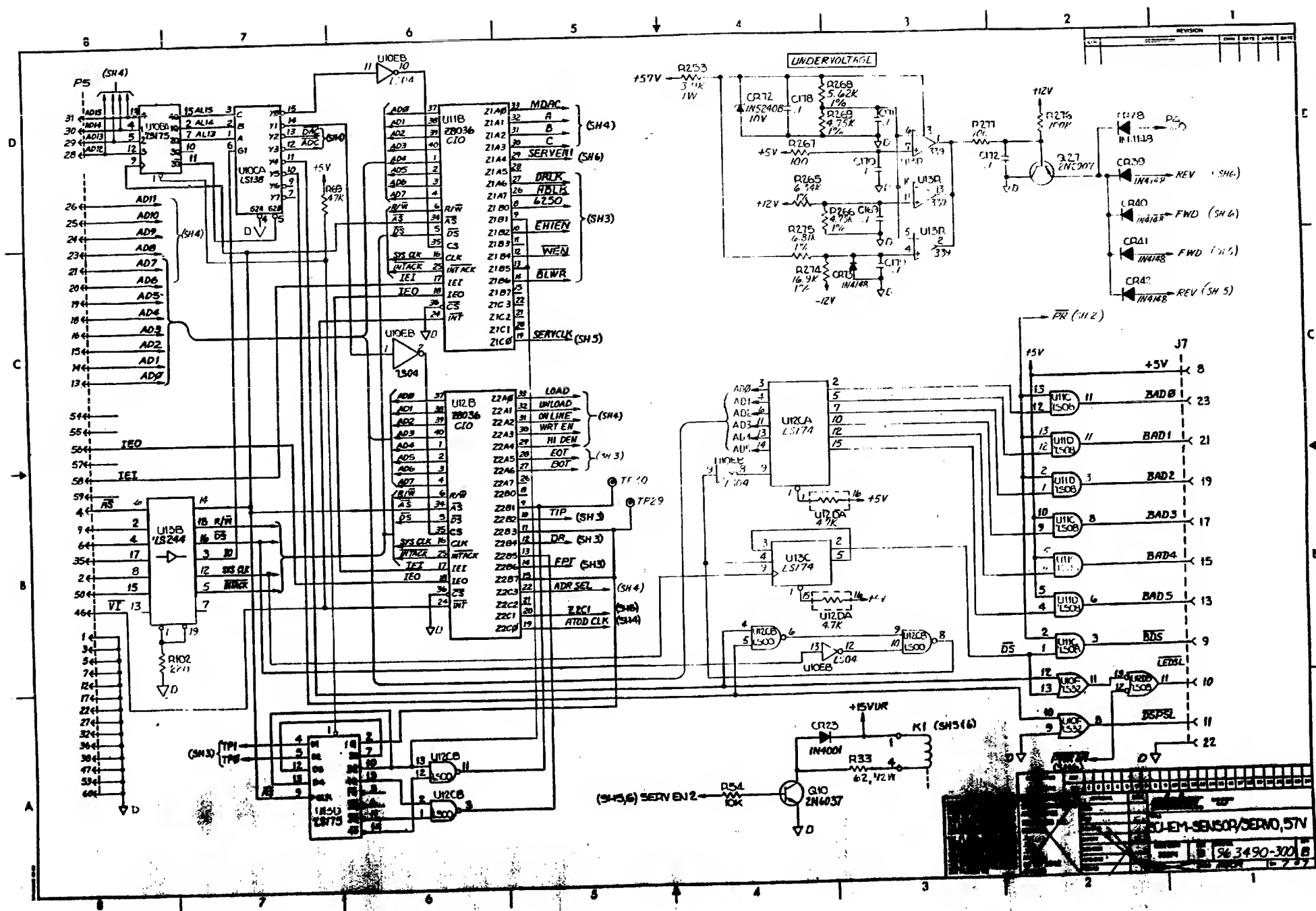












CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,57U
 MODEL:
 ECO NO: 30807
 DATE OF LAST ECO: 9/07/88

DATE OF LAST ECU: 970788												DAYS		REFERENCE		EFFECTIV		OBSOLETE	
PART NUMBER	DESCRIPTION	O P	R U	ITEM NO.	QTY ASSEMBLY	PER YIELD	FACTR	UM	SC	R E P O F	DEFAULT QUANTITY	OFF SET	SEQ	DESIGNATOR	DATE	DATE	DATE	DATE	
963490-000	PICT-PWB ASSY,SENSOR SERVO,57U	3	D	1	0.000	1.000	EA	F	Y	N	0.000	0	0		11/14/85	99/99/99			
963491-101	PWB-SENSOR/SERVO,37U,57U	1	C	2	1.000	1.000	EA	B	Y	N	1.000	0	0		11/14/85	99/99/99			
961234-400	SPECIFICATION-TEST.	3	A	3	0.000	1.000	EA	F	N	N	0.000	0	0		00/00/00	99/99/99			
963490-300	SCHEM-SENSOR SERVO,57U	3	C	4	0.000	1.000	EA	F	Y	N	0.000	0	0		11/14/85	99/99/99			
964398-001	INDUCTOR-DUAL,1500UH	1	A	5	1.000	1.000	EA	B	Y	N	1.000	0	0	L1,2	4/02/87	99/99/99			
970440-180	INDUCTOR-180UH,+/-10%,	3	B	6	1.000	1.000	EA	B	N	N	1.000	0	0	L10	00/00/00	99/99/99			
962906-001	INDUCTOR-EMI FILTER	1	A	7	1.000	1.000	EA	B	Y	N	1.000	0	0	L9	00/00/00	99/99/99			
962904-001	XFMR-CURRENT,SENSE	1	B	8	1.000	1.000	EA	B	Y	N	1.000	0	0	CT1	00/00/00	99/99/99			
971037-001	HEATSINK-STUD MOUNT	3	A	9	4.000	1.000	EA	B	Y	N	4.000	0	0	Q17,20,23,26	3/25/87	99/99/99			
971037-002	HEATSINK-STUD MOUNT	3	A	10	8.000	1.000	EA	B	Y	N	8.000	0	0	Q15,16,18,19,21,22,24,25	3/25/87	99/99/99			
962903-001	CHOKE-DUAL MOTOR	3	A	11	2.000	1.000	EA	B	Y	N	2.000	0	0	L4/L5,L6/L7 ECO#30189	11/23/87	99/99/99			
962908-003	XFMR-PWM,57 VOLT	1	C	12	1.000	1.000	EA	B	Y	N	1.000	0	0	T1	3/25/87	99/99/99			
971015-001	HEATSINK-TO-3,TOP MOUNT GOLD	3	A	13	1.000	1.000	EA	B	Y	N	1.000	0	0	CR10	3/12/87	99/99/99			
970388-001	HEATSINK-"U" BLACK	3	C	14	1.000	1.000	EA	B	N	N	1.000	0	0	UR4	00/00/00	99/99/99			
970281-002	HEATSINK-TO-127/TO-220,	3	C	15	3.000	1.000	EA	B	Y	N	3.000	0	0	UR1-3 ECO#30189	11/23/87	99/99/99			
970281-001	HEATSINK-TO-127/TO-220,	3	C	16	2.000	1.000	EA	B	Y	N	2.000	0	0	Q4,Q5	00/00/00	99/99/99			
970287-001	HEATSINK-TO-3,6.4,C/W	3	C	18	1.000	1.000	EA	B	N	N	1.000	0	0	CR10	00/00/00	99/99/99			
970460-001	NUT-SYNC,6-32,HEATSINK,.220MAX	3	D	19	8.000	1.000	EA	B	Y	N	8.000	0	0	UR1-4,Q2,45,CR10 ECO#30189	11/23/87	99/99/99			
213271-605	SCREW-PHP,ZINC,6-32X5/16	3	G	20	6.000	1.000	EA	F	Y	N	6.000	0	0		12/13/85	99/99/99			
964400-001	CHOKE-+5U	1	A	21	1.000	1.000	EA	B	Y	N	1.000	0	0	L11	3/25/87	99/99/99			
970083-001	INJECTOR/EJECTOR-1/16"	3	B	22	2.000	1.000	EA	B	N	N	2.000	0	0		00/00/00	99/99/99			
961707-002	STIFFENER-EDGE,PCB	3	B	24	1.000	1.000	EA	B	Y	N	1.000	0	0		00/00/00	99/99/99			
213271-603	SCREW-PHP,ZINC,6-32X3/16	3	G	25	1.000	1.000	EA	F	Y	N	1.000	0	0		3/27/86	99/99/99			
207602-011	WASHER-SPLIT LOCK #6	3	C	26	12.000	1.000	EA	F	Y	N	12.000	0	0		4/02/87	99/99/99			
207604-081	NUT-HEX RADIO PATTERN	3	B	27	12.000	1.000	EA	F	Y	N	12.000	0	0		4/02/87	99/99/99			
213271-606	SCREW-PHP,ZINC,6-32X3/8	3	G	28	2.000	1.000	EA	F	Y	N	2.000	0	0	CR10	4/02/87	99/99/99			
201114-274	CAP-CER,2700PF,50V,10%,X7R	3	J	30	2.000	1.000	EA	B	Y	N	2.000	0	0	95,94	00/00/00	99/99/99			
201114-224	CAP-CER,2200PF,50V,10%,X7R	3	J	33	4.000	1.000	EA	B	Y	N	4.000	0	0	105,109,113,114	00/00/00	99/99/99			
201191-025	CAP-ELEC,10MF,25V,ALUM	3	H	34	14.000	1.000	EA	B	Y	N	14.000	0	0	C1,16-18,28-31,48,6075,162,180186	00/00/00	99/99/99			

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 2

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERV0,57U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P R U	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201114-106	CAP-CER,100000PF,50V,10%,X7R	3 J	35	17.000	1.000	EA	B	Y N	17.000	0	0 C23,27,36, 38,42,130, 131,137-13 9,167,169- 172,179,18 5 ECO#3018 9	11/23/87	99/99/99
201158-100	CAP-MYLAR,.1MF,100V,10%	3 E	36	6.000	1.000	EA	B	Y N	6.000	0	0 C10,48-50, 144,148	12/09/86	99/99/99
970565-001	CAP-ELEC,1000MF,25V.-20+50%	3 A	37	2.000	1.000	EA	B	Y N	2.000	0	0 C4,5	00/00/00	99/99/99
971031-102	CAP-ELEC,1000-1200 MF,100V,LOW	3 B	38	2.000	1.000	EA	B	Y N	2.000	0	0 C6,183	3/16/87	99/99/99
971034-103	CAP-ELEC.10000-12000 MF 6.3U*	3 B	39	1.000	1.000	EA	B	Y N	1.000	0	0 C15	3/16/87	99/99/99
201114-564	CAP-CER,5600PF,50V,10%,X7R	3 J	41	1.000	1.000	EA	B	Y N	1.000	0	0 C43	3/12/87	99/99/99
201114-220	CAP-CER,.022MF,50V,10%	3 J	42	8.000	1.000	EA	B	Y N	8.000	0	0 88,101,102 110,111,12 6,155,156	00/00/00	99/99/99
201123-151	CAP-DM,1500PF,100V,5%	3 E	43	1.000	1.000	EA	B	N N	1.000	0	0 C71	00/00/00	99/99/99
201160-472	CAP-TANT,4.7MF,10V,10%	3 D	44	2.000	1.000	EA	B	Y N	2.000	0	0 C41,173	00/00/00	99/99/99
970712-002	CAP-POLY..001MF,200V MIN,5%	3 C	45	2.000	1.000	EA	B	Y N	2.000	0	0 C8,9	12/04/85	99/99/99
970712-004	CAP-POLYPRO,.022UF,200-250V+*	3 A	48	2.000	1.000	EA	B	N N	2.000	0	0 C13,14	00/00/00	99/99/99
201204-153	CAP-CER,150PF,50V,5%,NPO	3 R	49	1.000	1.000	EA	B	Y N	1.000	0	0 C70	00/00/00	99/99/99
201114-105	CAP-CER,10000PF,50V,10%,X7R	3 J	50	23.000	1.000	EA	B	Y N	23.000	0	0 C22,24,26, 37,39,53-5 7,59.62,63 66,67.92,1 03,104,106 112,129,13 3,136	12/04/85	99/99/99
970712-001	CAP-POLY..0033MF,250-400V,5%	3 A	51	1.000	1.000	EA	B	Y N	1.000	0	0 C11	3/12/87	99/99/99
201161-470	CAP-TANT,47MF,6V,10%	3 P	52	4.000	1.000	EA	B	N N	4.000	0	0 C119-121,1 84	00/00/00	99/99/99
201120-500	CAP-DM,5PF,300V,+/-1/2PF,	3 C	53	1.000	1.000	EA	B	N N	1.000	0	0 C96	00/00/00	99/99/99
201114-155	CAP-CER,15000PF,50V,10%,X7R	3 J	57	2.000	1.000	EA	B	Y N	2.000	0	0 152,163	3/11/87	99/99/99
201114-475	CAP-CER,47000PF,50V,10%,X7R	3 J	58	9.000	1.000	EA	B	Y N	9.000	0	0 115-118,97 -100,166	00/00/00	99/99/99
970712-003	CAP-POLY,.068MF,200VDC,5%	3 D	60	4.000	1.000	EA	B	Y N	4.000	0	0 C44-47	12/04/85	99/99/99
201106-107	CAP-CER,1MF,50V,10%	3 M	61	5.000	1.000	EA	B	Y N	5.000	0	0 C21,25,87, 175,177	00/00/00	99/99/99
201113-470	CAP-CER,.0047MF,50V,10%	3 H	62	9.000	1.000	EA	B	Y N	9.000	0	0 86,122,123 127,128,14 1,142,149	00/00/00	99/99/99

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 PEV: E PWB ASSY-SENSOR SERVO,57U
 MODEL:
 ECO NO: 30807
 DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970712-005	CAP-POLYPRO.0047UF,200-250V,++	3	A	63	2.000	1.000	EA	B	N	N	2.000	0	0 C140.146	00/00/00 99/99/99
201204-221	CAP-CER.2.2PF,50V,5%,NPO	3	R	64	1.000	1.000	EA	B	Y	N	1.000	0	0 C132	4/02/87 99/99/99
201204-473	CAP-CER.470PF,50V,5%,NPO	3	R	65	2.000	1.000	EA	B	N	N	2.000	0	0 C168.157	00/00/00 99/99/99
970784-104	CAP-CER..1UF,50V,-20+80%,AX,*	3	E	67	44.000	1.000	EA	B	Y	N	44.000	0	0 C2.3.12,19 20,32-35,5 1,58.61.64 65,69,68,7 2-74,76-80 82-84,89-9 1,93,107,1 08,124,125 134,135,15 8-161,174, 176,178	1/09/87 99/99/99
201114-104	CAP-CER.1000PF,50V,10%,X7R	3	J	68	4.000	1.000	EA	B	Y	N	4.000	0	0 C143.145,1 50,151	00/00/00 99/99/99
201112-220	CAP-CER.220PF,50V.10%	3	E	69	2.000	1.000	EA	B	Y	N	2.000	0	0 153.164	3/11/87 99/99/99
970085-001	CAP-DM,680PF,300V,1%	3	B	70	1.000	1.000	EA	B	N	N	1.000	0	0 C81	00/00/00 99/99/99
201105-474	CAP-CER..47MF,50V,10%	3	N	72	3.000	1.000	EA	B	Y	N	3.000	0	0 85,165.154	00/00/00 99/99/99
962003-001	SPEC-8" PWR & GND BUS BAR	1	A	73	1.000	1.000	EA	B	Y	N	1.000	0	0	00/00/00 99/99/99
962002-001	SPEC-15" PWR & GND BUS BAR	1	B	74	1.000	1.000	EA	B	Y	N	1.000	0	0	00/00/00 99/99/99
970551-002	BUS BAR STIFFENER-INSULATED	3	B	75	1.000	1.000	EA	B	Y	N	1.000	0	0	00/00/00 99/99/99
970724-001	DIODE-1N4448,FAST SWITCHING	3	A	87	4.000	1.000	EA	B	Y	N	4.000	0	0 CR18-21	00/00/00 99/99/99
202033	DIODE-RECTIFIER,	3	F	88	2.000	1.000	EA	B	N	N	2.000	0	0 CR14.15	00/00/00 99/99/99
970562-001	DIODE-RECTIFIER,POWER	3	C	89	4.000	1.000	EA	B	Y	N	4.000	0	0 CR6-9	00/00/00 99/99/99
202032-300	DIODE-ZENER	3	C	90	1.000	1.000	EA	B	Y	N	1.000	0	0 CR25	00/00/00 99/99/99
202018-100	DIODE-SWITCHING,1N4148	3	E	91	29.000	1.000	EA	B	Y	N	29.000	0	0 CR12,24,28 -42,49-51, 54,63-65,6 8,71,73-75	00/00/00 99/99/99
971049-001	DIODE-1N5230B,ZENER,4.7V,5%	3	A	92	1.000	1.000	EA	B	Y	N	1.000	0	0 CR11	5/15/87 99/99/99
202005-500	RECTIFIER-PWR,HI EFF,6A	3	C	93	16.000	1.000	EA	B	N	N	16.000	0	0 CR43-48,52 ,53,57-62, 66,67	00/00/00 99/99/99
202011	DIODE-RECTIFIER 1 AMP	3	G	94	1.000	1.000	EA	B	Y	N	1.000	0	0 CR13	3/11/87 99/99/99
202009-999	DIODE RECTIFIER,1 AMP	3	D	95	8.000	1.000	EA	B	Y	N	8.000	0	0 CR1-4,22, 23,26,27	3/27/86 99/99/99
202031	DIODE-ZENER	3	E	96	5.000	1.000	EA	B	Y	N	5.000	0	0 CR55,56,69 70,72	12/09/86 99/99/99
202032	DIODE-ZENER	3	E	98	1.000	1.000	EA	B	N	N	1.000	0	0 CR5	00/00/00 99/99/99
970238-001	DIODE-RECTIFIER,DUAL	3	C	99	1.000	1.000	EA	B	N	N	1.000	0	0 CR10	00/00/00 99/99/99

ORIGINAL

BILL OF MATERIAL
 =====
 AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,57U
 MODEL:
 ECO NO: 30807
 DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
202006-100	DIODE-LIGHT EMITTING	3	H	101	1.000	1.000	EA	B	N N	1.000	0	0 DS1	00/00/00	99/99/99
970208-001	CONNECTOR HEADER SOCKET-	3	A	107	1.000	1.000	EA	B	N N	1.000	0	0 J1	00/00/00	99/99/99
970288-001	CONN-HEADER,50 POSN,PIN,	3	B	109	1.000	1.000	EA	B	N N	1.000	0	0 J7	00/00/00	99/99/99
970291-001	CONN-HEADER,8 POSN,PIN,	3	A	110	1.000	1.000	EA	B	N N	1.000	0	0 J8	00/00/00	99/99/99
970581-001	RECTIFIER-.8AMP 60V	3	A	115	1.000	1.000	EA	B	Y N	1.000	0	1 Q1	00/00/00	99/99/99
970563-001	TRANSISTOR-NPN,SILICON	3	A	118	1.000	1.000	EA	B	Y N	1.000	0	0 Q2	00/00/00	99/99/99
970249-001	TRANSISTOR-PNP,SILICON,	3	C	119	1.000	1.000	EA	B	N N	1.000	0	0 Q27	00/00/00	99/99/99
204007-500	TRANSISTOR-NPN SILICON	3	J	120	2.000	1.000	EA	B	N N	2.000	0	0 Q3,9	00/00/00	99/99/99
970582-001	TRANSISOR-N CHANNEL	3	A	121	2.000	1.000	EA	B	Y N	2.000	0	0 Q4,5	00/00/00	99/99/99
204027-037	TRANSISTOR-NPN SILICON	3	E	122	2.000	1.000	EA	B	Y N	2.000	0	0 Q10,11	00/00/00	99/99/99
204027-034	TRANSISTOR-PNP SILICON	3	E	123	4.000	1.000	EA	B	N N	4.000	0	0 Q6,7,13,14	00/00/00	99/99/99
970545-001	TRANSISTOR-POWER, MOS FET	3	A	124	4.000	1.000	EA	B	Y N	4.000	0	0 Q15,16,21,22	00/00/00	99/99/99
971033-001	TRANS-TIP29B,NPN TO-220	3	B	126	4.000	1.000	EA	B	Y N	4.000	0	0 Q17,20,23,26	3/16/87	99/99/99
204013-999	TRANSISTOR-NPN SILICON	3	E	127	2.000	1.000	EA	B	Y N	2.000	0	0 Q8,12	3/25/87	99/99/99
970546-001	TRANSISTOR-POWER, MOS FET	3	A	128	4.000	1.000	EA	B	Y N	4.000	0	0 Q18,19,24,25	12/09/86	99/99/99
200076-100	RES-1.0 MOHM 1/4W 5% CF	3	AC	129	2.000	1.000	EA	F	Y N	2.000	0	0 R165,177	00/00/00	99/99/99
200120-400	RES-4.0 OHM 3.0W 5% WW	3	H	130	1.000	1.000	EA	F	Y N	1.000	0	0 R147	00/00/00	99/99/99
200121-100	RES-10 OHM 3.0W 5% WW	3	H	131	1.000	1.000	EA	F	Y N	1.000	0	0 R148	00/00/00	99/99/99
200013-562	RES-5.62 KOHM 1/4W 1% FF	3	R	135	1.000	1.000	EA	F	Y N	1.000	0	0 R268	00/00/00	99/99/99
200013-200	RES-2.0 KOHM 1/4W 1% FF	3	R	136	5.000	1.000	EA	B	N N	5.000	0	0 R72,73,76,77,80	00/00/00	99/99/99
200014-750	RES-75.0 KOHM 1/4W 1% FF	3	R	137	1.000	1.000	EA	B	Y N	1.000	0	0 R79	11/14/85	99/99/99
200073-100	RES-1.0 KOHM 1/4W 5% CF	3	AC	138	17.000	1.000	EA	F	Y N	17.000	0	0 R52,53,56,61,86,103,104,110,164,172-176,245,264,281 ECO#3018	11/23/87	99/99/99
200013-634	RES-6.34 KOHM 1/4W 1% FF	3	R	139	1.000	1.000	EA	F	N N	1.000	0	0 R265	00/00/00	99/99/99
200013-100	RES-1.00 KOHM 1/4W 1% FF	3	R	140	6.000	1.000	EA	F	N N	6.000	0	0 R15,70,78,89-91	00/00/00	99/99/99
200073-470	RES-4.7 KOHM 1/4W 5% CF	3	AC	141	12.000	1.000	EA	F	Y N	12.000	0	0 R64,66,69,163,182,230,232,234,236,262,261,272	00/00/00	99/99/99
200016-100	RES-1.00 MOHM 1/8W 1% FF	3	R	143	1.000	1.000	EA	F	Y N	1.000	0	0 R109	00/00/00	99/99/99

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO.57U
 MODEL:
 ECO NO: 30807
 DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	Q P	ITEM RU	QTY NO.	PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200013-499	RES-4.99 KOHM 1/4W 1% FF	3	R	144	13.000	1.000	EA	F	N N	13.000	0	0	R83,84,93- 95,126,127 135,136,2 41,242,258 259	00/00/00	99/99/99
200072-390	RES-390 OHM 1/4W 5% CF	3	AC	145	6.000	1.000	EA	F	N N	6.000	0	0	R41,49,184 225,226,2 79	00/00/00	99/99/99
200071-820	RES-82 OHM 1/4W 5% CF	3	AC	146	1.000	1.000	EA	F	N N	1.000	0	0	R48	00/00/00	99/99/99
200013-221	RES-2.21 KOHM 1/4W 1% FF	3	R	147	2.000	1.000	EA	F	N N	2.000	0	0	R74,75	00/00/00	99/99/99
971030-025	RES-FUSIBLE..25 OHM,2W+5%	3	A	148	8.000	1.000	EA	B	Y N	8.000	0	0	R185,186.1 88,189,206 207,209,21 0	3/16/87	99/99/99
970536-047	RES-47 OHM,2W,5%,CF,FIXED	3	C	149	2.000	1.000	EA	B	Y N	2.000	0	0	R187,208	00/00/00	99/99/99
200014-402	RES-40.2 KOHM 1/4W 1% FF	3	R	150	12.000	1.000	EA	F	Y N	12.000	0	0	R112,113,1 21,124,125 128,129,1 33,134,137 139,140	00/00/00	99/99/99
200013-402	RES-4.02 KOHM 1/4W 1% FF	3	R	151	1.000	1.000	EA	B	Y N	1.000	0	0	R14	11/21/85	99/99/99
200013-249	RES-2.49 KOHM 1/4W 1% FF	3	R	152	1.000	1.000	EA	F	N N	1.000	0	0	R82	00/00/00	99/99/99
200073-220	RES-2.2 KOHM 1/4W 5% CF	3	AC	153	3.000	1.000	EA	F	N N	3.000	0	0	R81,106,18 0	00/00/00	99/99/99
200072-330	RES-330 OHM 1/4W 5% CF	3	AC	155	6.000	1.000	EA	F	Y N	6.000	0	0	R35,85,116 117,143,14 4	00/00/00	99/99/99
200073-270	RES-2.7 KOHM 1/4W 5% CF	3	AC	156	5.000	1.000	EA	F	Y N	5.000	0	0	R57,58,60. 68,183 ECO #30189	11/23/87	99/99/99
200071-200	RES-20 OHM 1/4W 5% CF	3	AC	157	3.000	1.000	EA	F	Y N	3.000	0	0	R10,11,55	00/00/00	99/99/99
200071-510	RES-51 OHM 1/4W 5% CF	3	AC	158	1.000	1.000	EA	F	Y N	1.000	0	0	R38	00/00/00	99/99/99
200073-150	RES-1.5 KOHM 1/4W 5% CF	3	AC	159	5.000	1.000	EA	F	Y N	5.000	0	0	R44,46,50 51,65	00/00/00	99/99/99
200073-510	RES-5.1 KOHM 1/4W 5% CF	3	AC	160	10.000	1.000	EA	F	Y N	10.000	0	0	R45,47,162 157,158,1 61,213,221 192,201	00/00/00	99/99/99
200082-120	RES-120 OHM 1/2W 5% CF	3	L	161	2.000	1.000	EA	B	N N	2.000	0	0	R3,4	00/00/00	99/99/99
970969-047	RES-FUSIBLE,47OHM,1/2W,5% MF	3	C	162	6.000	1.000	EA	B	Y N	6.000	0	0	R19,20,193 202,214,22	3/16/87	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 6

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERV.D.570
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

DP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/D PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	D P RU	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970969-047	RES-FUSIBLE,470HM,1/2W,5% MF	3 C	162	6.000	1.000	EA	B	Y N	6.000	0	0 2	3/16/87	99/99/99
200071-470	RES-47 DHM 1/4W 5% CF	3 AC	163	4.000	1.000	EA	F	Y N	4.000	0	0 R197.205.2	00/00/00	99/99/99
200123-200	RES-2K DHM,3.0W,5%,WW	3 H	164	1.000	1.000	EA	B	Y N	1.000	0	0 R2	3/25/87	99/99/99
970568-472	RES-4.7 KOHM 1W 5% CF	3 D	165	1.000	1.000	EA	B	Y N	1.000	0	0 R6	00/00/00	99/99/99
970271-002	RES-20 OHM 2W 5% FC	3 A	166	2.000	1.000	EA	B	N N	2.000	0	0 R62.63	00/00/00	99/99/99
200070-560	RES-5.6 OHM 1/4W 5% CF	3 AC	167	2.000	1.000	EA	F	N N	2.000	0	0 R149.150	00/00/00	99/99/99
200074-100	RES-10 KOHM 1/4W 5% CF	3 AC	168	17.000	1.000	EA	F	Y N	17.000	0	0 R7,8,23,34 ,54,67,111 ,120,130,1 ,38,153,154 ,169,194,2 00,215,220	00/00/00	99/99/99
200081-620	RES-62 OHM 1/2W 5% CF	3 L	169	1.000	1.000	EA	B	Y N	1.000	0	0 R33	3/16/87	99/99/99
200074-220	RES-22 KOHM 1/4W 5% CF	3 AC	170	2.000	1.000	EA	F	N N	2.000	0	0 R105.181	00/00/00	99/99/99
200013-750	RES-7.5 KOHM 1/4W 1% FF	3 R	171	1.000	1.000	EA	F	Y N	1.000	0	0 R263	00/00/00	99/99/99
200074-560	RES-56 KOHM 1/4W 5% CF	3 AC	172	2.000	1.000	EA	F	Y N	2.000	0	0 R239.256	3/11/87	99/99/99
200073-360	RES-3.6 KOHM 1/4W 5% CF	3 AC	173	4.000	1.000	EA	F	Y N	4.000	0	0 R237.238.2	00/00/00	99/99/99
971416-750	RES-7.5 OHM,5%,1W,CF	3 A	174	2.000	1.000	EA	F	Y N	2.000	0	0 R42,R43 ECD#30807	9/06/88	99/99/99
200072-430	RES-430 DHM 1/4W 5% CF	3 AC	175	2.000	1.000	EA	F	Y N	2.000	0	0 R166.178	00/00/00	99/99/99
200074-120	RES-12 KOHM 1/4W 5% CF	3 AC	176	1.000	1.000	EA	F	Y N	1.000	0	0 R168	2/21/86	99/99/99
200013-301	RES-3.01 KOHM 1/4W 1% FF	3 R	177	4.000	1.000	EA	F	Y N	4.000	0	0 R36,37,39. 71	00/00/00	99/99/99
200072-220	RES-220 DHM 1/4W 5% CF	3 AC	178	3.000	1.000	EA	F	Y N	3.000	0	0 R96,102.24	00/00/00	99/99/99
970568-392	RES-3.9 KOHM 1W 5% CF	3 D	179	1.000	1.000	EA	B	Y N	1.000	0	0 R253	00/00/00	99/99/99
200076-130	RES-1.3 MOHM 1/4W 5% CF	3 AC	180	1.000	1.000	EA	F	Y N	1.000	0	0 R170	12/09/86	99/99/99
200075-100	RES-100 KOHM 1/4W 5% CF	3 AC	182	7.000	1.000	EA	F	Y N	7.000	0	0 R24,25,26. 31,260,273 ,276	00/00/00	99/99/99
200072-100	RES-100 OHM 1/4W 5% CF	3 AC	183	4.000	1.000	EA	F	Y N	4.000	0	0 R159,160,2	00/00/00	99/99/99
200075-220	RES-220 KOHM 1/4W 5% CF	3 AC	184	1.000	1.000	EA	F	Y N	1.000	0	0 R271	00/00/00	99/99/99
200072-470	RES-470 OHM 1/4W 5% CF	3 AC	185	5.000	1.000	EA	F	Y N	5.000	0	0 R27,249,25	00/00/00	99/99/99
200074-330	RES-33 KOHM 1/4W 5% CF	3 AC	186	3.000	1.000	EA	F	N N	3.000	0	0 R32,98,99	00/00/00	99/99/99
200076-470	RES-4.7 MOHM 1/4W 5% CF	3 AC	187	1.000	1.000	EA	F	N N	1.000	0	0 R100	00/00/00	99/99/99
200072-200	RES-200 OHM 1/4W 5% CF	3 AC	188	6.000	1.000	EA	F	Y N	6.000	0	0 R22,179.19	11/23/87	99/99/99
											6,198,217,		

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERV0,57U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	ITEM RU	QTY NO.	PER ASSEMBLY	YIELD FACTR	UM	SC	R E	P F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200072-200	RES-200 OHM 1/4W 5% CF	3	AC	188	6.000	1.000	EA	F	Y	N	6.000	0	0	218 ECO#30 189	11/23/87	99/99/99
200071-150	RES-15 OHM 1/4W 5% CF	3	AC	189	1.000	1.000	EA	F	N	N	1.000	0	0	R21	00/00/00	99/99/99
200072-150	RES-150 OHM 1/4W 5% CF	3	AC	190	1.000	1.000	EA	F	Y	N	1.000	0	0	R152	00/00/00	99/99/99
200015-200	RES-200 KOHM 1/4W 1% FF	3	R	192	4.000	1.000	EA	B	Y	N	4.000	0	0	R122,123,1 31,132	11/06/85	99/99/99
200074-470	RES-47 KOHM 1/4W 5% CF	3	AC	193	3.000	1.000	EA	F	Y	N	3.000	0	0	R171,243,2 70	00/00/00	99/99/99
200071-120	RES-12 OHM 1/4W 5% CF	3	AC	194	1.000	1.000	EA	F	N	N	1.000	0	0	R151	00/00/00	99/99/99
200013-475	RES-4.75 KOHM 1/4W 1% FF	3	R	195	2.000	1.000	EA	F	N	N	2.000	0	0	R266.269	00/00/00	99/99/99
200014-169	RES-16.9 KOHM 1/4W 1% FF	3	R	196	1.000	1.000	EA	B	N	N	1.000	0	0	R274	00/00/00	99/99/99
200073-300	RES-3 KOHM 1/4W 5% CF	3	AC	197	3.000	1.000	EA	F	Y	N	3.000	0	0	R156.248.2 51	00/00/00	99/99/99
200073-680	RES-6.8 KOHM 1/4W 5% CF	3	AC	200	5.000	1.000	EA	F	N	N	6.000	0	0	R12.233,23 5,229,231	00/00/00	99/99/99
200074-110	RES-11 KOHM 1/4W 5% CF	3	AC	201	1.000	1.000	EA	F	N	N	1.000	0	0	R155	00/00/00	99/99/99
970537-002	RES-100 OHM 5% 5W WW	3	A	202	1.000	1.000	EA	B	Y	N	1.000	0	0	R5	00/00/00	99/99/99
200071-100	RES-10 OHM 1/4W 5% CF	3	AC	204	4.000	1.000	EA	F	Y	N	4.000	0	0	R195,199,2 16,219	00/00/00	99/99/99
200148-100	RES-0.10 OHM 6.5W 5% WW	3	D	205	1.000	1.000	EA	F	N	N	1.000	0	0	R278	00/00/00	99/99/99
200074-390	RES-39 KOHM 1/4W 5% CF	3	AC	206	1.000	1.000	EA	F	N	N	1.000	0	0	R17	00/00/00	99/99/99
200073-390	RES-3.9 KOHM 1/4W 5% CF	3	AC	207	1.000	1.000	EA	F	Y	N	1.000	0	0	R18	00/00/00	99/99/99
200014-909	RES-90.9 KOHM 1/4W 1% FF	3	R	208	1.000	1.000	EA	F	N	N	1.000	0	0	R40	00/00/00	99/99/99
200011-100	RES-10.0 OHM 1/4W 1% FF	3	R	209	1.000	1.000	EA	B	Y	N	1.000	0	0	R16	11/21/85	99/99/99
200013-806	RES-8.06 KOHM 1/4W 1% FF	3	R	210	1.000	1.000	EA	F	N	N	1.000	0	0	R30	00/00/00	99/99/99
200014-100	RES-10.0 KOHM 1/4W 1% FF	3	R	211	4.000	1.000	EA	F	Y	N	4.000	0	0	R28.29.240 257	00/00/00	99/99/99
200013-681	RES-6.81 KOHM 1/4W 1% FF	3	R	212	1.000	1.000	EA	F	Y	N	1.000	0	0	R275	00/00/00	99/99/99
200073-200	RES-2 KOHM 1/4W 5% CF	3	AC	213	4.000	1.000	EA	F	Y	N	4.000	0	0	R13.59,97, 244 ECO#30 189	11/23/87	99/99/99
200012-200	RES-200 OHM 1/4W 1% FF	3	R	214	1.000	1.000	EA	B	N	N	1.000	0	0	R92	00/00/00	99/99/99
970568-201	RES-200 OHM 1W 5% CF	3	D	215	8.000	1.000	EA	B	Y	N	8.000	0	0	R190,191,2 03,204,211 212.223,22 4	00/00/00	99/99/99
200072-680	RES-680 OHM 1/4W 5% CF	3	AC	216	10.000	1.000	EA	F	Y	N	10.000	0	0	R107,114,1 15,118,119 141,142,14 5,146,167	00/00/00	99/99/99
200073-330	RES-3.3 KOHM 1/4W 5% CF	3	AC	217	1.000	1.000	EA	F	N	N	1.000	0	0	R108	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 8

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,57U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200076-180	RES-1.8 MOHM 1/4W 5% CF	3	AC	218	1.000	1.000	EA	B	N	N	1.000	0	0	R10i	00/00/00	99/99/99
200012-750	RES-750 OHM 1/4W 1% FF	3	R	219	2.000	1.000	EA	B	N	N	2.000	0	0	R87.88	00/00/00	99/99/99
200073-620	RES-6.2 KOHM 1/4W 5% CF	3	AC	220	3.000	1.000	EA	F	Y	N	3.000	0	0	R1.9.247	2/21/86	99/99/99
205248-200	RES-NETWK 4.7 KOHM DIP	3	B	222	1.000	1.000	EA	B	Y	N	1.000	0	0	U12DA	5/15/86	99/99/99
970843-001	RES-NET-SIP,220 OHM,ISOL	3	B	223	2.000	1.000	EA	B	Y	N	2.000	0	0	RP1,RP2	5/16/86	99/99/99
970267-001	PIN-TEST,.040SQ X .360LG	3	A	245	39.000	1.000	EA	F	Y	N	39.000	0	0	TP1-39	00/00/00	99/99/99
970989-001	IC-74ALS05,INVERTER,OPEN COLTR	3	A	249	1.000	1.000	EA	B	Y	N	1.000	0	0	U7D	3/12/87	99/99/99
203007-700	IC-339 VOLT COMP QUAD	3	J	250	6.000	1.000	EA	B	N	N	6.000	0	0	U4D,U10J,U 11L,U12J,U 12K,U13R	00/00/00	99/99/99
970554-001	IC-3525 MOD PULSE WIDT	3	C	251	1.000	1.000	EA	B	Y	N	1.000	0	0	U4F	00/00/00	99/99/99
203052-051	IC-4051 MUX 8 CH	3	C	252	2.000	1.000	EA	B	N	N	2.000	0	0	U8C,U9E	00/00/00	99/99/99
970025-001	IC-556 TIMER DUAL	3	C	253	1.000	1.000	EA	B	Y	N	1.000	0	0	U4C	00/00/00	99/99/99
203130-999	IC-082 OP AMP JFET IN	3	F	254	4.000	1.000	EA	B	N	N	4.000	0	0	U8B,U8D,U9 A,U9C	00/00/00	99/99/99
203550-501	IC-1001 CONU A-D 10BIT 170NS	3	E	255	1.000	1.000	EA	B	Y	N	1.000	0	0	U10CB	00/00/00	99/99/99
970454-001	IC-7533 CONU D-A 10BIT	3	C	256	1.000	1.000	EA	B	N	N	1.000	0	0	U10AA	00/00/00	99/99/99
203082-500	IC-7407N BUF DRU HEX	3	E	258	2.000	1.000	EA	B	N	N	2.000	0	0	U9J,U10EA	00/00/00	99/99/99
203012-136	IC-4136 OP AMP QUAD	3	J	259	3.000	1.000	EA	B	N	N	3.000	0	0	U7J,U11M,U 11P	00/00/00	99/99/99
203555-111	IC-8036 CIO 16BIT 6MHZ	3	C	265	2.000	1.000	EA	B	N	N	2.000	0	0	U11B,U12D	00/00/00	99/99/99
970010-001	IC-74LS08 AND 2IN QUAD	3	B	266	3.000	1.000	EA	B	N	N	3.000	0	0	U11C,U11D, U12DB	00/00/00	99/99/99
203085-001	IC-74LS14 INU SCHMITT HEX	3	J	267	1.000	1.000	EA	B	Y	N	1.000	0	0	U11F	00/00/00	99/99/99
203029-003	IC-74LS11 AND 3IN TRIP	3	F	269	2.000	1.000	EA	B	N	N	2.000	0	0	U10KA,U10K B	00/00/00	99/99/99
203039-001	IC-74LS74 FF D DUAL	3	M	270	1.000	1.000	EA	B	N	N	1.000	0	0	U11R	00/00/00	99/99/99
970221-001	IC-74LS00 NAND 2IN POS QUAD	3	E	272	1.000	1.000	EA	B	N	N	1.000	0	0	U12CB	00/00/00	99/99/99
203046-001	IC-74LS123 MLTU DUAL	3	G	273	2.000	1.000	EA	B	N	N	2.000	0	0	U13M,U13P	00/00/00	99/99/99
203051-100	IC-74LS175 FF D QUAD	3	G	274	2.000	1.000	EA	B	N	N	2.000	0	0	U10BA,U13D	00/00/00	99/99/99
731006-800	LABEL-ASSY	3	B	278	1.000	1.000	EA	F	N	N	1.000	0	0		00/00/00	99/99/99
203046-148	IC-74LS138 DCDR 3-8 LINE	3	K	279	1.000	1.000	EA	B	N	N	1.000	0	0	U10CA	00/00/00	99/99/99
203035-032	IC-74LS32 OR 2IN QUAD	3	J	280	1.000	1.000	EA	B	N	N	1.000	0	0	U10F	00/00/00	99/99/99
203029-500	IC-7414 INU HEX SCHMITT TRIP.	3	C	281	1.000	1.000	EA	B	Y	N	1.000	0	0	U7E	00/00/00	99/99/99
203052-378	IC-74LS378 FF D HEX	3	D	282	2.000	1.000	EA	B	N	N	2.000	0	0	U10AB,U10B B	00/00/00	99/99/99
203051-174	IC-74LS174,FF,D,HEX	3	L	283	2.000	1.000	EA	B	Y	N	2.000	0	0	U12CA,U13C	5/15/86	99/99/99
970011-001	IC-74LS04 INU HEX	3	D	284	1.000	1.000	EA	B	N	N	1.000	0	0	U10EB	00/00/00	99/99/99
203052-244	IC-74LS244 BFR OCT 3S	3	L	285	1.000	1.000	EA	B	N	N	1.000	0	0	U13B	00/00/00	99/99/99
203009-005	IC-084 OP AMP BIFET	3	F	291	1.000	1.000	EA	B	Y	N	1.000	0	0	U12F	12/09/86	99/99/99
203013-317	IC-78L05 VOLT REG +5V 5%	3	E	296	1.000	1.000	EA	B	N	N	1.000	0	0	UR5	00/00/00	99/99/99

END

BILL OF MATERIAL
=====

AS OF 12/30/93

OP: ORDER POLICY CODE
REQ: N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963490-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,57U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

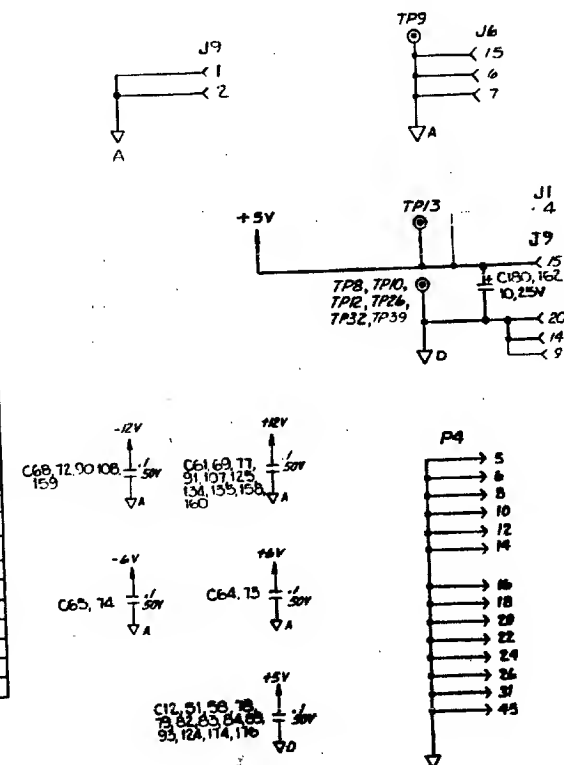
PART NUMBER	DESCRIPTION	O P	RU	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
203013-210	IC-7812 VOLT REG -12V 1A	3	F	297	1.000	1.000	EA	B	N N	1.000	0	0	UR2	00/00/00	99/99/99
203013-300	IC-7912 VOLT REG,12V,1.5AMPS	3	L	298	1.000	1.000	EA	B	N N	1.000	0	0	UR3	00/00/00	99/99/99
970002-001	IC-7906 VOLT REG -6V	3	A	300	1.000	1.000	EA	B	N N	1.000	0	0	UR1	00/00/00	99/99/99
970255-001	IC-7808 VOLT REG +8V 1A	3	B	301	1.000	1.000	EA	B	N N	1.000	0	0	UR4	00/00/00	99/99/99
209990-071	ADHESIVE-SUPERBONDER	3	C	308	0.000	1.000	EA	F	Y N	0.000	0	0		11/22/85	99/99/99
213020-605	SCREW- 6-32X5/16,BDR HD,SLOT	3	A	309	1.000	1.000	EA	F	Y N	1.000	0	0		3/27/86	99/99/99
213700-609	WASHER-FLAT,NYLON,SM PAT	3	C	310	1.000	1.000	EA	F	Y N	1.000	0	0		12/04/85	99/99/99
970559-001	NUT-ACORN CAP 6-32 NYLON	3	A	311	1.000	1.000	EA	B	Y N	1.000	0	0		12/04/85	99/99/99
209990-063	ADHESIVE-DOW CORNING 3145	3	A	312	.001	1.000	EA	F	Y N	.001	0	0	ECO#30707	6/23/88	99/99/99
970548-002	RELAY-DPDT,7.5 AMP,12V,PC	3	C	313	1.000	1.000	EA	B	Y N	1.000	0	0	K1	3/12/87	99/99/99
971041-001	LABEL-BAR CODE,1.425LX.25W,9.*	3	B	315	1.000	1.000	EA	F	Y N	1.000	0	0		00/00/00	99/99/99
965042-001	LABEL-CAUTION	3	A	316	1.000	1.000	EA	F	Y N	1.000	0	0	ECO#30243	1/27/88	99/99/99

ORIGINAL

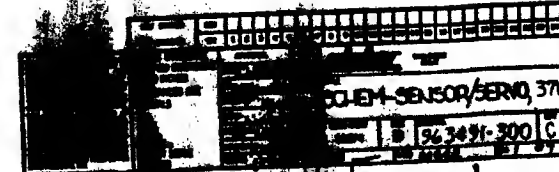
UNUSED GATES		
TYPE	REF. DESIGN.	INPUT (OUTPUT)
339	8,9 (14)	
339	8,9 (14)	
4136	1,2 (3)	
7406	3(4)-11(10)	
7407	1(2)-3(4)-5(6)-9(8)	
7407	13(2)	
74LS08	1,2,3-4,5(6)-9,10(8)	
74LS14	9(8)	
74LS123	6,7,9,10,11(5,12)	
74LS32	1,2 (3)	
7414	9(8)-11(10)-13(12)	

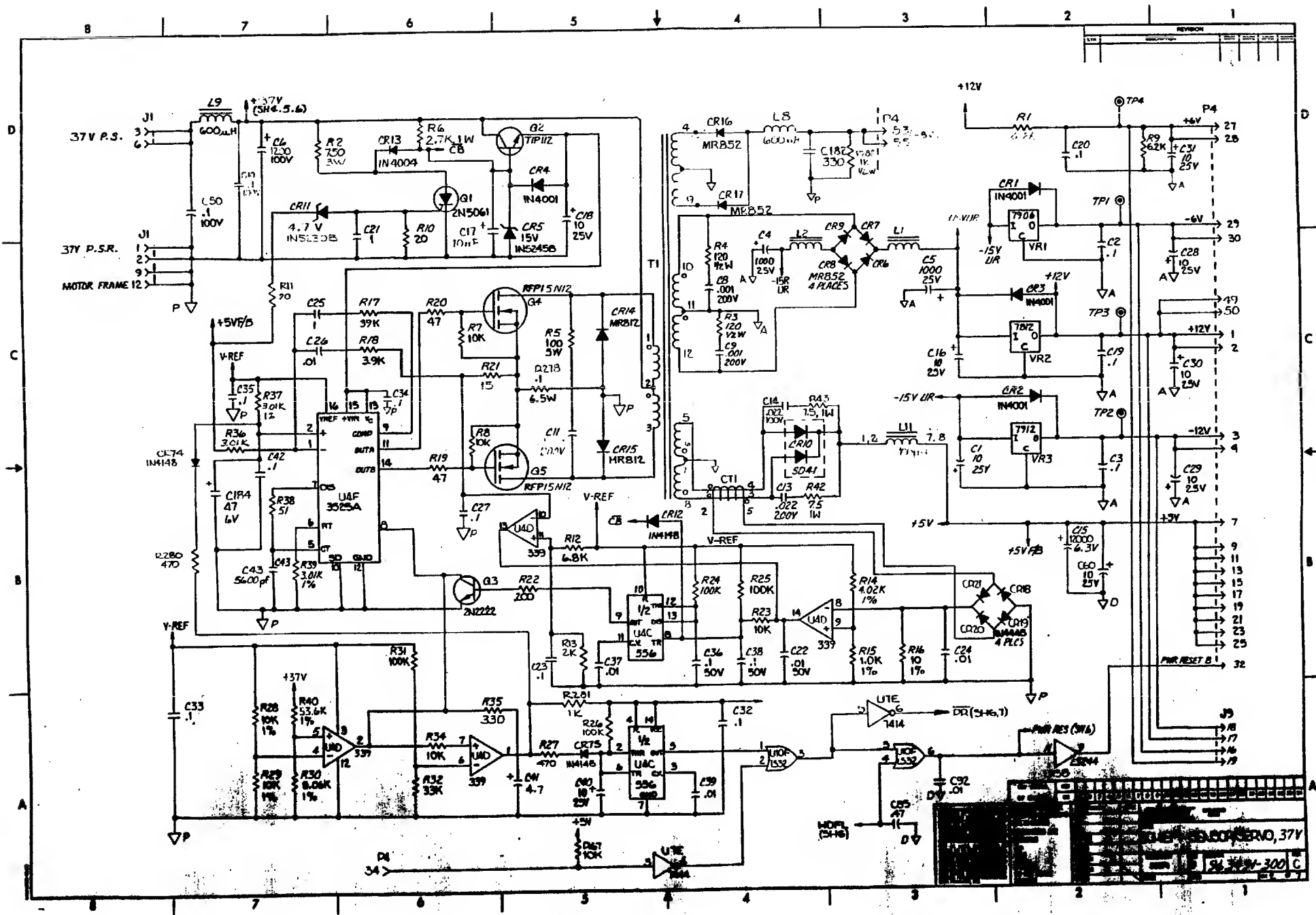
REFERENCE DESIGNATION		
LTR	LAST USED	NOT USED
C		
CR		
DS		
J		
K		
L		
Q		
R		
T		
U		
VR		
TP		

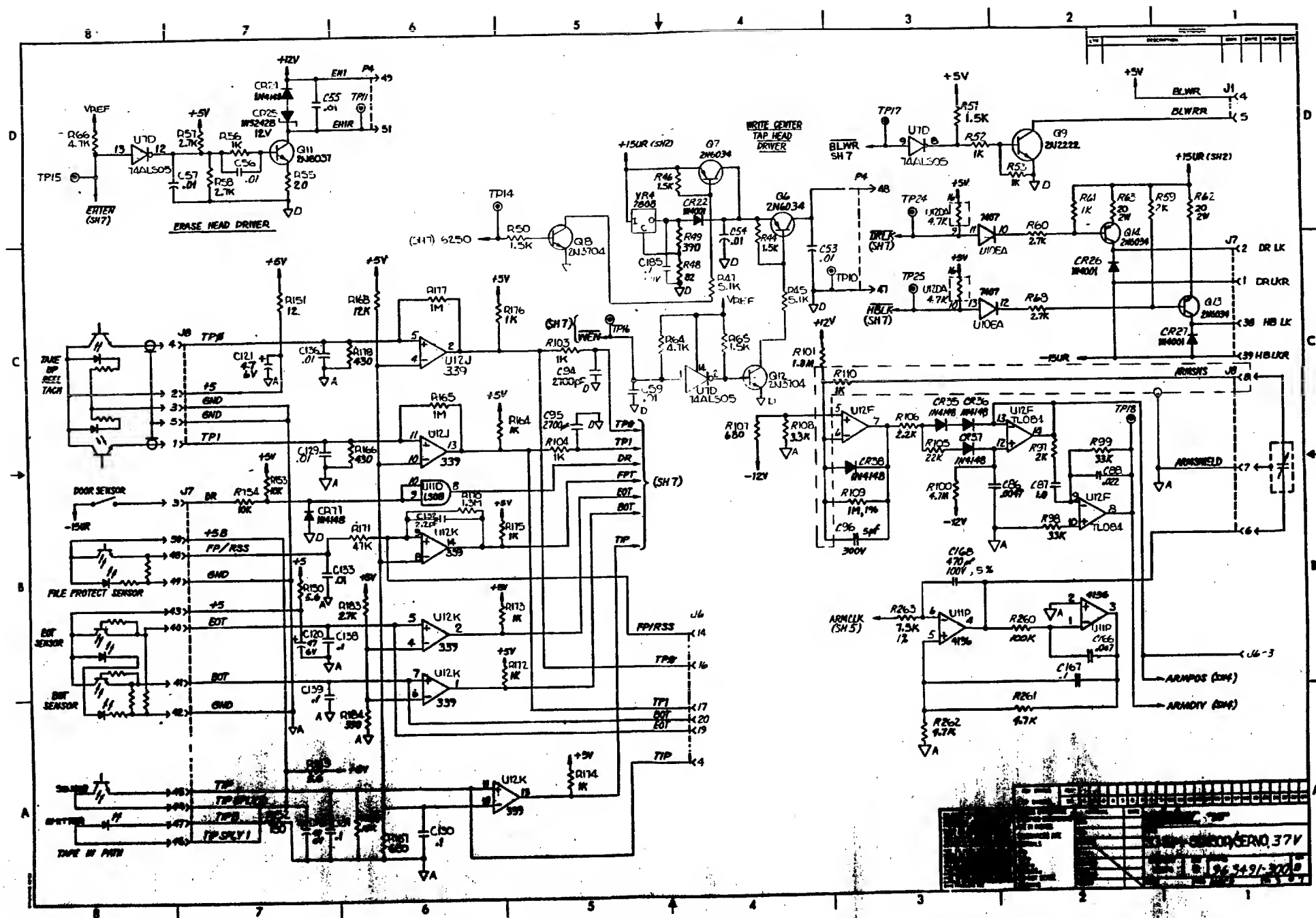
IC TYPE	REFERENCE DESIGNATOR	+5V	OGND	+12	-12	+6	-6	PEND	AGND
74LS08	U11D, U11C, U12DB	14	7						
74LS11	U10KB, U10KA	14	7						
74LS14	U11F	14	7						
74LS04	U10EB	14	7						7
74LS74	U11R								
74LS123	U13M, U13P	16	8						
74LS138	U10CA	16	8						
74LS175	U10BA, U13D	16	8						
74LS378	U10AB, U10BE	16	8						
74LS244	U13B	20	10						
74LS00	U12CB	14	7						
74LS32	U10F	14	7						12
LM339	U4D	14	7						
LM3505	U7D	14	7						
7407	U10EA, U9J	14	7						
7414	U7E		12						
LM339				3	12				
LM339	U11L			8	4				
TL082	U8B, U8D, U9A, U9C			3					12
LM337	U10J, U12J, U12K, U13R								
NE555AN	U4C								7
TL084	U12F				11				
RC136	U7J, U11M, U11P			11	7				
MD14051	U8C, U9E					16	7		8
AD7533LN	U10AA			14					3
ADC1001	U10CB								7,8
74LS174	U12CA, U13C	16	8						
74LS36	U11B, U12B	23	7						

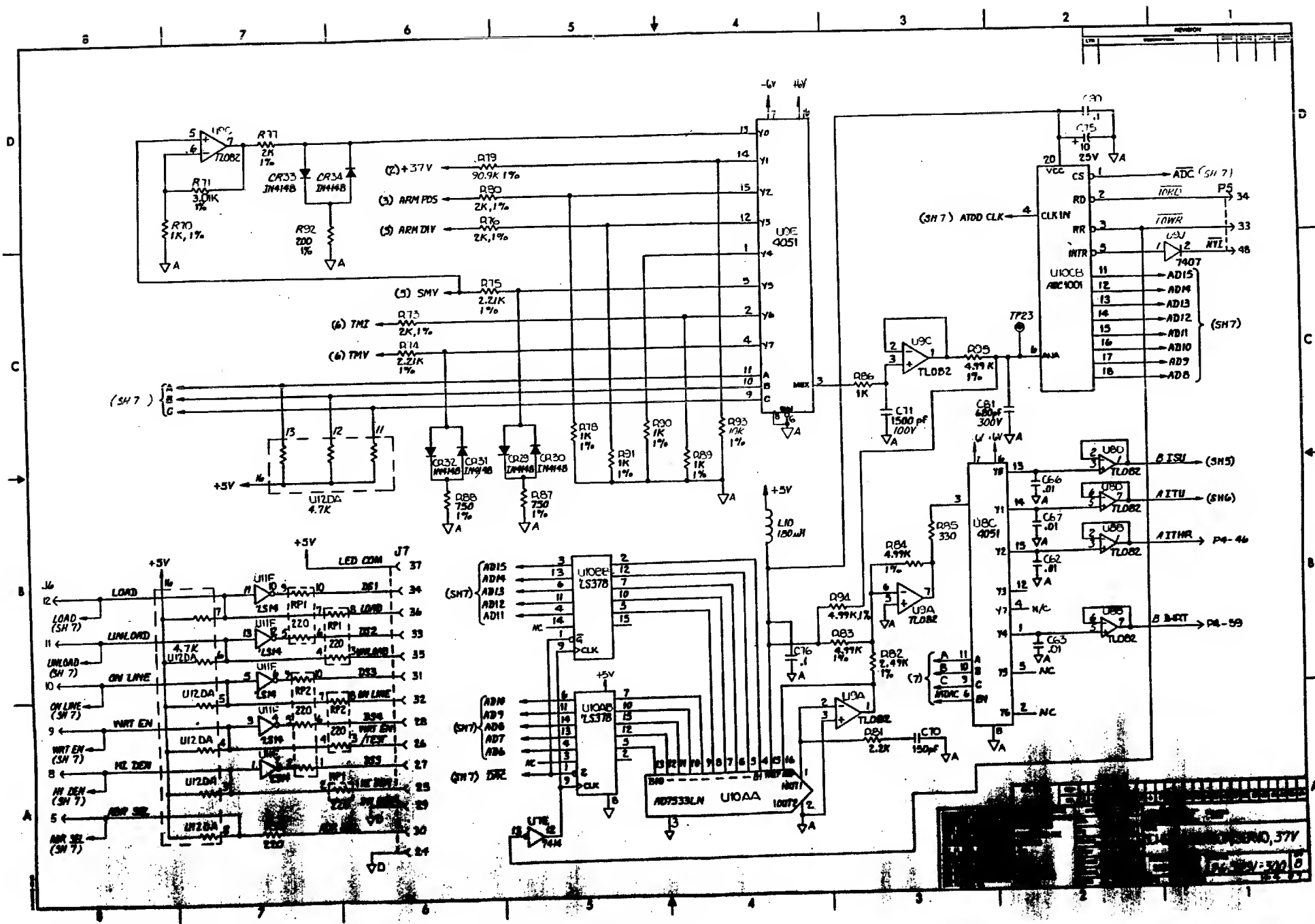


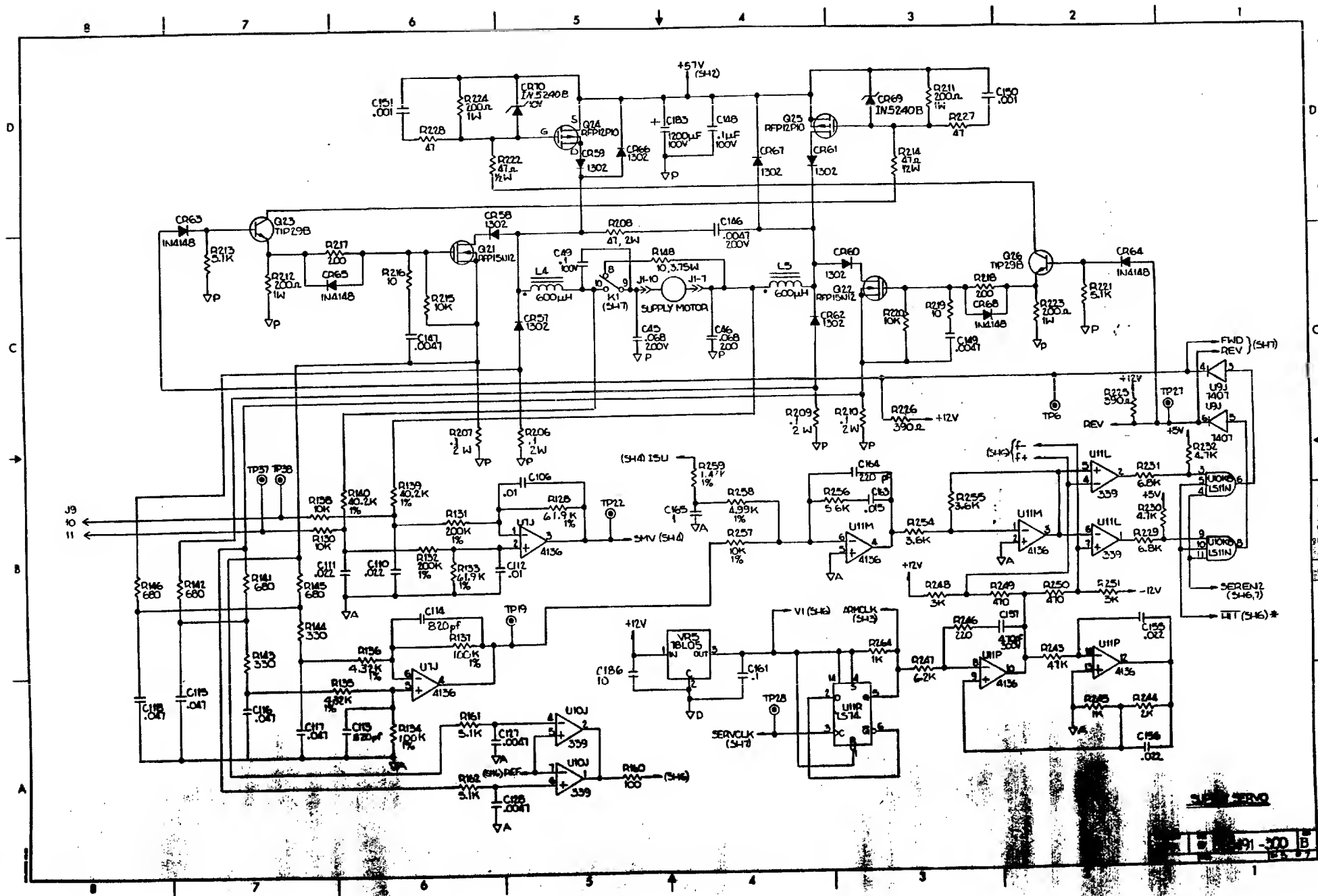
1. 1/8 W RESISTORS ARE ASSIGNED AS 1%.
 2. IC VOLTAGE AND GND ASSIGNMENTS
 3. CAPACITOR VALUES ARE IN MICROFARADS, 50V.
 4. RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
 NOTES: UNLESS OTHERWISE SPECIFIED.

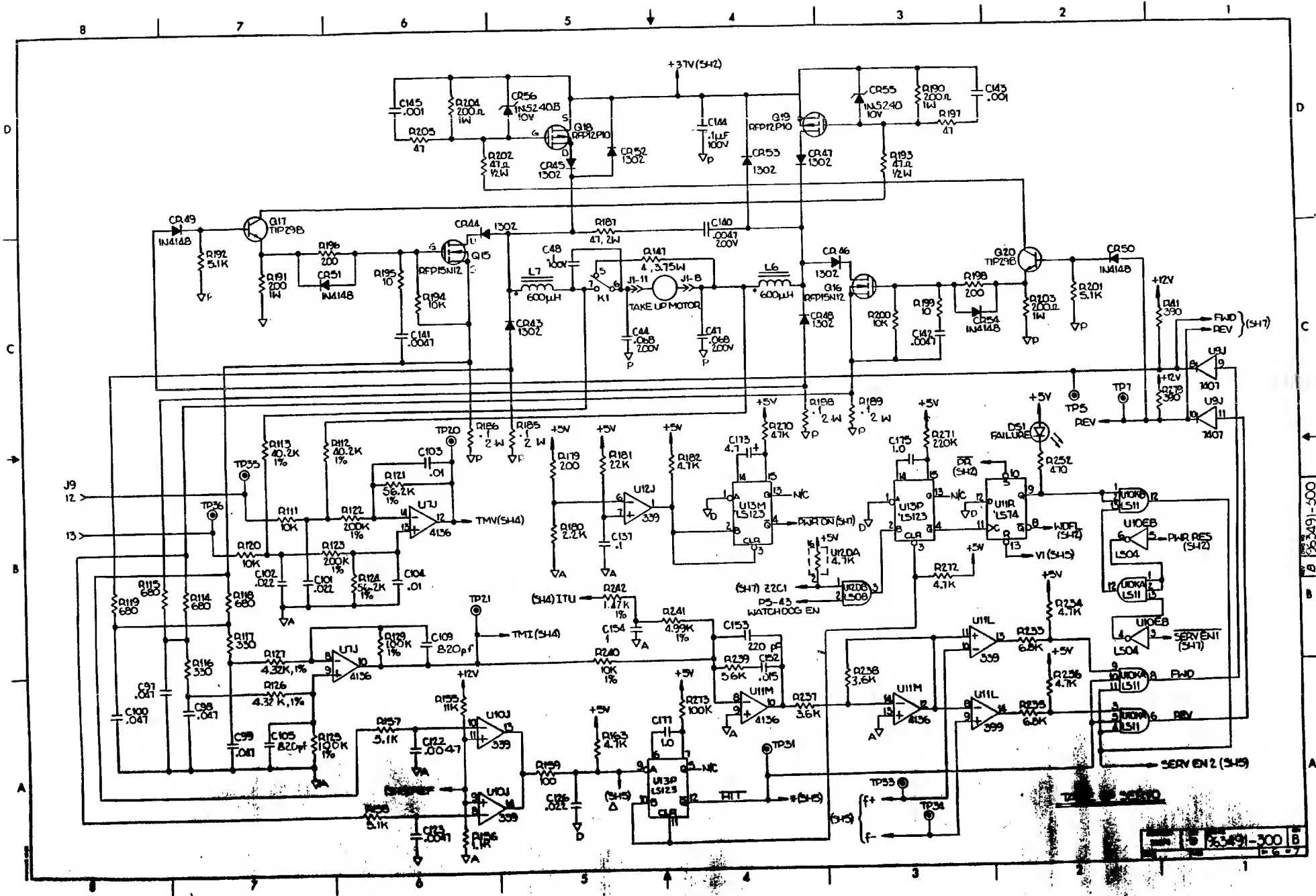


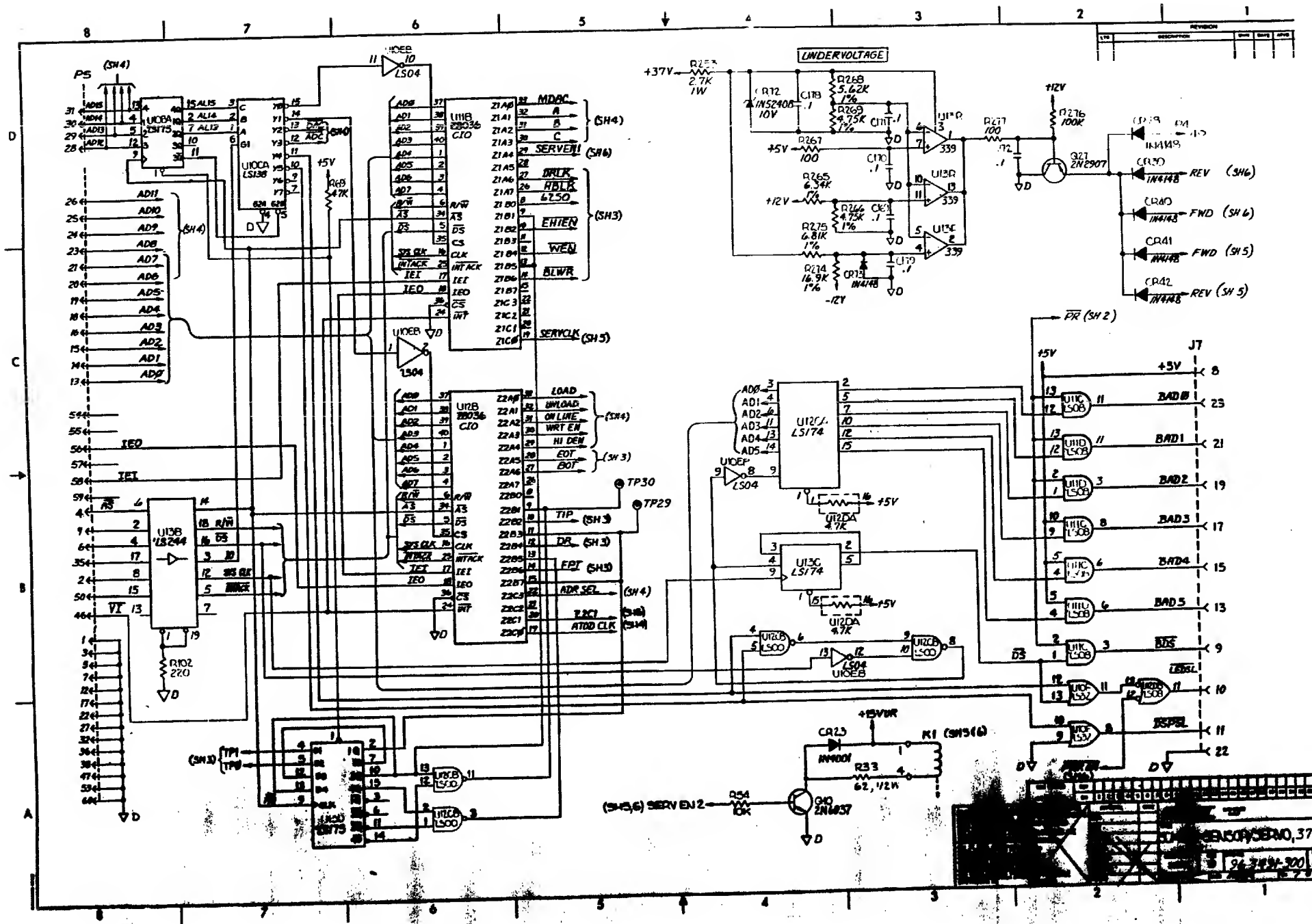




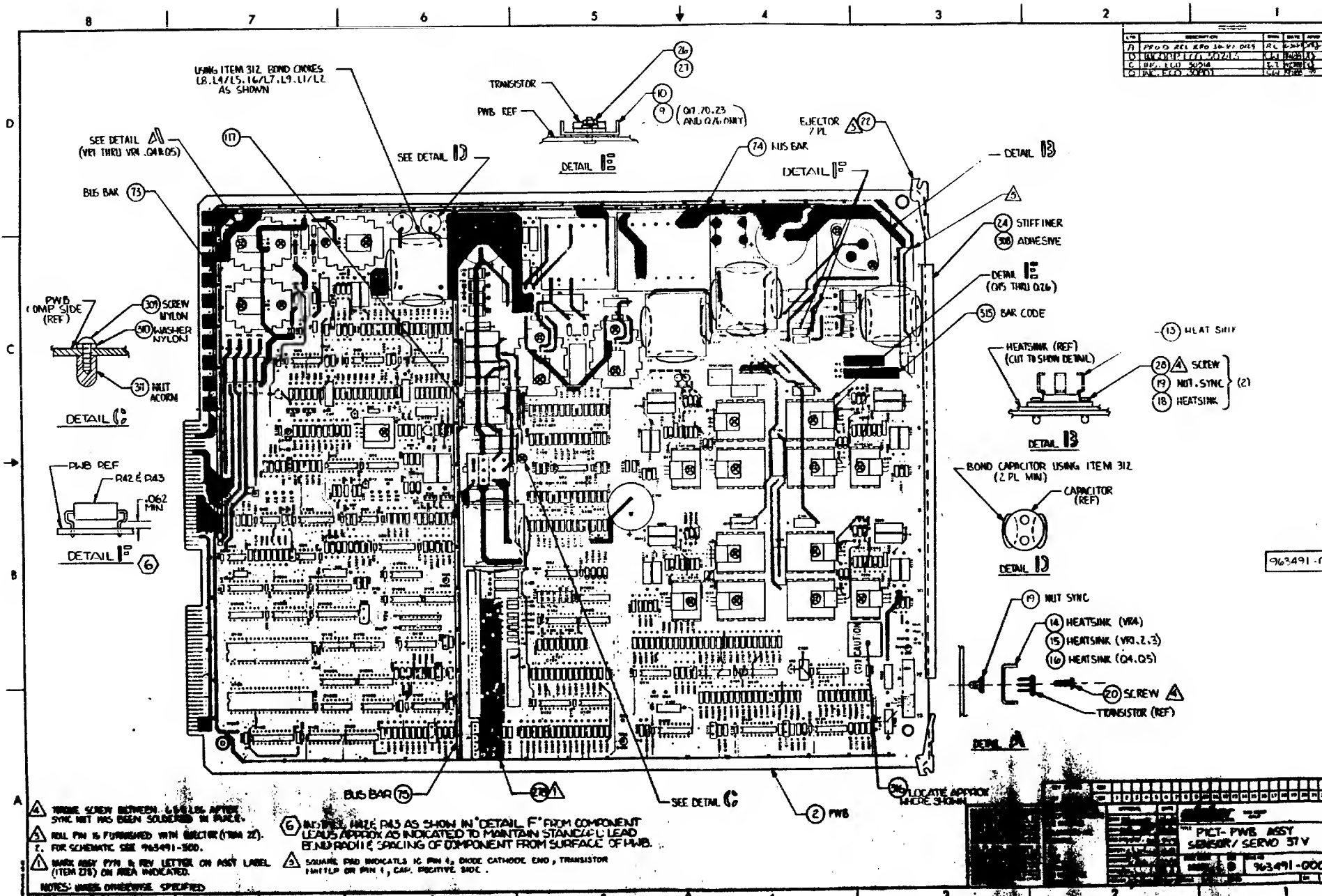








REV	DESCRIPTION	DATE	BY
1	PROD REL KPD 30-VI D14	RL	2/2/73
2	W/COMP 1771, 1772, 1773	RL	2/28/73
3	W/LED 5024	RL	3/2/73
4	W/LED 5024	RL	3/2/73



963491-000

PCT-PWB ASSY
SENSOR/SERVO 31V
963491-000

- NOTE: UNLESS OTHERWISE SPECIFIED
- 1. TIGHTEN SCREW BETWEEN 4-6 INCHES AFTER SYNC NUT HAS BEEN SOLDERED IN PLACE.
 - 2. ROLL PIN IS FURNISHED WITH ORIENTOR (ITEM 22).
 - 3. FOR SCHEMATIC SEE 963491-300.
 - 4. MARK ASSY PYN & REV LETTER ON ASSY LABEL (ITEM 278) ON AREA INDICATED.
 - 5. INSURE SIZE P43 AS SHOWN IN DETAIL F FROM COMPONENT LEADS APPROX AS INDICATED TO MAINTAIN STANDARD LEAD BOND RADIUS SPACING OF COMPONENT FROM SURFACE OF PWB.
 - 6. SQUARE PAD INDICATES IC PIN 1, DIODE CATHODE END, TRANSISTOR EMITTER OR PIN 1, CAP. POSITIVE SIDE.

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,37U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER FACTR	YIELD UM	SC	R E	P F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963491-000	PICT-PWB ASSY,SENSOR SERVO,37U	3	O	1	0.000	1.000	EA	F	Y	N	0.000	0	0		11/14/85	99/99/99
963491-101	PWB-SENSOR/SERVO,37U,57U	1	C	2	1.000	1.000	EA	B	Y	N	1.000	0	0		11/14/85	99/99/99
961234-400	SPECIFICATION-TEST,	3	A	3	0.000	1.000	EA	F	N	N	0.000	0	0		00/00/00	99/99/99
963491-300	SCHEM-SENSOR SERVO,37U	3	C	4	0.000	1.000	EA	F	Y	N	0.000	0	0	L1,2	12/12/85	99/99/99
964398-001	INDUCTOR-DUAL,1500UH	1	A	5	1.000	1.000	EA	B	Y	N	1.000	0	0	L10	4/02/87	99/99/99
970440-180	INDUCTOR-180UH,+/-10%,	3	B	6	1.000	1.000	EA	B	N	N	1.000	0	0	L9	00/00/00	99/99/99
962906-001	INDUCTOR-EMI FILTER	1	A	7	1.000	1.000	EA	B	Y	N	1.000	0	0	CT1	00/00/00	99/99/99
962904-001	XFMR-CURRENT,SENSE	1	B	8	1.000	1.000	EA	B	Y	N	1.000	0	0	Q17,20,23,	3/25/87	99/99/99
971037-001	HEATSINK-STUD MOUNT	3	A	9	4.000	1.000	EA	B	Y	N	4.000	0	0	26		
971037-002	HEATSINK-STUD MOUNT	3	A	10	8.000	1.000	EA	B	Y	N	8.000	0	0	Q15,16,18, 19,21,22,2 4,25	3/25/87	99/99/99
962903-001	CHOKE-DUAL MOTOR	3	A	11	2.000	1.000	EA	B	Y	N	2.000	0	0	L4/L5,L6/L 7 ECO#3018 9	11/23/87	99/99/99
962908-004	XFMR-PWM,37 VOLT	1	C	12	1.000	1.000	EA	B	Y	N	1.000	0	0	T1	3/25/87	99/99/99
971015-001	HEATSINK-TO-3,TOP MOUNT GOLD	3	A	13	1.000	1.000	EA	B	Y	N	1.000	0	0	CR10	3/12/87	99/99/99
970388-001	HEATSINK-"U" BLACK	3	C	14	1.000	1.000	EA	B	N	N	1.000	0	0	UR4	00/00/00	99/99/99
970281-002	HEATSINK-TO-127/TO-220,	3	C	15	3.000	1.000	EA	B	Y	N	3.000	0	0	UR1-3	00/00/00	99/99/99
970281-001	HEATSINK-TO-127/TO-220,	3	C	16	2.000	1.000	EA	B	Y	N	2.000	0	0	Q4,Q5	00/00/00	99/99/99
964399-001	INDUCTOR-600UH	1	A	17	1.000	1.000	EA	B	Y	N	1.000	0	0	L8	3/25/87	99/99/99
970287-001	HEATSINK-TO-3,6.4,C/W	3	C	18	1.000	1.000	EA	B	N	N	1.000	0	0	CR10	00/00/00	99/99/99
970460-001	NUT-SYNC,6-32,HEATSINK,.220MAX	3	O	19	8.000	1.000	EA	B	Y	N	8.000	0	0	UR1-4,Q2,4 5,CR10 ECO #30189	11/23/87	99/99/99
213271-605	SCREW-PHP,ZINC,6-32X5/16	3	G	20	6.000	1.000	EA	F	Y	N	6.000	0	0		00/00/00	99/99/99
964400-001	CHOKE-+5V	1	A	21	1.000	1.000	EA	B	Y	N	1.000	0	0	L11	3/25/87	99/99/99
970083-001	INJECTOR/EJECTOR-1/16"	3	B	22	2.000	1.000	EA	B	N	N	2.000	0	0		00/00/00	99/99/99
961707-002	STIFFENER-EDGE,PCB	3	B	24	1.000	1.000	EA	B	Y	N	1.000	0	0		00/00/00	99/99/99
213271-603	SCREW-PHP,ZINC,6-32X3/16	3	G	25	1.000	1.000	EA	F	Y	N	1.000	0	0		3/27/86	99/99/99
207602-011	WASHER-SPLIT LOCK #6	3	C	26	12.000	1.000	EA	F	Y	N	12.000	0	0		4/02/87	99/99/99
207604-081	NUT-HEX RADIO PATTERN	3	B	27	12.000	1.000	EA	F	Y	N	12.000	0	0		4/02/87	99/99/99
213271-606	SCREW-PHP,ZINC,6-32X3/8	3	G	28	2.000	1.000	EA	F	Y	N	2.000	0	0	ECO#30189	11/23/87	99/99/99
201114-274	CAP-CER,2700PF,50V,10%,X7R	3	J	30	2.000	1.000	EA	B	Y	N	2.000	0	0	C94,95	00/00/00	99/99/99
201112-820	CAP-CER,820PF,50V,10%	3	L	33	4.000	1.000	EA	B	Y	N	4.000	0	0	C105,109,1 13,114	12/09/85	99/99/99
201191-025	CAP-ELEC,10MF,25V, ,ALUM	3	H	34	14.000	1.000	EA	B	Y	N	14.000	0	0	C1,16-18,2 8-31,40,60 75,162,180 186	00/00/00	99/99/99

L1,201,2.MDATAB01 CIPHER - SAN DIEGO - PRODUCTION DATA BASE
WED, SEP 7, 1988

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 2

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OPCODE: 4 REV: E PWB ASSY-SENSOR SERV0,37U

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P R V	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P O F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201191-025	CAP-ELEC,10MF,25V,ALUM	3 H	34	14.000	1.000	EA	B	Y N	14.000	0	0 186	00/00/00	99/99/99
201114-106	CAP-CER,100000PF,50V,10%,X7R	3 J	35	17.000	1.000	EA	B	Y N	17.000	0	0 C23,27, 36,38,42,1 30,131,137 138,139,1 67,169,170 171,172,1 79,185	5/30/86	99/99/99
201158-100	CAP-MYLAR,.1MF,100V,10%	3 E	36	6.000	1.000	EA	B	Y N	6.000	0	0 C10,48-50, 144,148	4/02/87	99/99/99
970565-001	CAP-ELEC,1000MF,25V,-20+50%	3 A	37	2.000	1.000	EA	B	Y N	2.000	0	0 C4,5	00/00/00	99/99/99
971031-102	CAP-ELEC,1000-1200 MF,100V,LOW	3 B	38	2.000	1.000	EA	B	Y N	2.000	0	0 C6,183	3/16/87	99/99/99
971034-103	CAP-ELEC,10000-12000 MF 6.3V*	3 B	39	1.000	1.000	EA	B	Y N	1.000	0	0 C15	3/16/87	99/99/99
201114-564	CAP-CER,5600PF,50V,10%,X7R	3 J	41	1.000	1.000	EA	B	Y N	1.000	0	0 C43	3/12/87	99/99/99
201114-220	CAP-CER,.022MF,50V,10%	3 J	42	8.000	1.000	EA	B	Y N	8.000	0	0 C88,101,10 2,110,111, 126,155,15 6	00/00/00	99/99/99
201123-151	CAP-DM,1500PF,100V,5%	3 E	43	1.000	1.000	EA	B	N N	1.000	0	0 C71	00/00/00	99/99/99
201160-472	CAP-TANT,4.7MF,10V,10%	3 D	44	2.000	1.000	EA	B	Y N	2.000	0	0 C41,173	00/00/00	99/99/99
970712-001	CAP-POLY,.0033MF,250-400V,5%	3 A	45	1.000	1.000	EA	B	Y N	1.000	0	0 C11	12/09/85	99/99/99
970712-004	CAP-POLYPRD,.022UF,200-250V+~*	3 A	48	2.000	1.000	EA	B	N N	2.000	0	0 C13,14	00/00/00	99/99/99
201204-153	CAP-CER,150PF,50V,5%,NPO	3 R	49	1.000	1.000	EA	B	Y N	1.000	0	0 C70	00/00/00	99/99/99
201114-105	CAP-CER,10000PF,50V,10%,X7R	3 J	50	23.000	1.000	EA	B	Y N	23.000	0	0 C22,24,26, 37,39,53-5 7,59,62,63 66,67,92,1 03,104,106 112,129,13 3,136	12/04/85	99/99/99
201161-470	CAP-TANT,47MF,6V,10%	3 P	52	4.000	1.000	EA	B	N N	4.000	0	0 C119-121,1 84	00/00/00	99/99/99
201120-500	CAP-DM,5PF,300V,+~1/2PF,	3 C	53	1.000	1.000	EA	B	N N	1.000	0	0 C96	00/00/00	99/99/99
201114-155	CAP-CER,15000PF,50V,10%,X7R	3 J	57	2.000	1.000	EA	B	Y N	2.000	0	0 C152,163	3/11/87	99/99/99
201114-475	CAP-CER,47000PF,50V,10%,X7R	3 J	58	9.000	1.000	EA	B	Y N	9.000	0	0 C97,98,99, 100,115,11 6,117,118, 166	00/00/00	99/99/99
971032-331	CAP-ELEC,330 MF,25V	3 A	59	1.000	1.000	EA	B	Y N	1.000	0	0 C182	3/16/87	99/99/99
970712-003	CAP-POLY,.068MF,200VDC,5%	3 D	60	1.000	1.000	EA	B	Y N	4.000	0	0 C44-47	12/04/85	99/99/99
201106	CAP-CER,1MF,50V,10%	3 M	61	1.000	1.000	EA	B	Y N	7.000	0	0 C21,25,87,	00/00/00	99/99/99

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY
963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERV0,37U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	FACTR UM	SC	R E	P F	DEFAULT QUANTITY	OFF SET	DAYS SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201106-107	CAP-CER,1MF,50V,10%	3	M	61	7.000	1.000	EA	B	Y	N	7.000	0	0	154,165,17 5,177	00/00/00	99/99/99
201113-470	CAP-CER,.0047MF,50V,10%	3	H	62	9.000	1.000	EA	B	Y	N	9.000	0	0	C86,122,12 3,127,128, 141,142,14 7,149	00/00/00	99/99/99
970712-005	CAP-POLYPRO.0047UF,200-250V,**	3	A	63	2.000	1.000	EA	B	N	N	2.000	0	0	C140,146	00/00/00	99/99/99
970712-002	CAP-POLY,.001MF,200V MIN,5%	3	C	64	2.000	1.000	EA	B	Y	N	2.000	0	0	C8,9	5/19/86	99/99/99
201204-473	CAP-CER,470PF,50V,5%,NPO	3	R	65	2.000	1.000	EA	B	N	N	2.000	0	0	C168,157	00/00/00	99/99/99
201204-221	CAP-CER,2.2PF,50V,5%,NPO	3	R	66	1.000	1.000	EA	B	Y	N	1.000	0	0	C132	4/02/87	99/99/99
970784-104	CAP-CER,.1UF,50V,-20+80%,AX,*	3	E	67	44.000	1.000	EA	B	Y	N	44.000	0	0	C2,3,12,19 20,32-35,5 1,58,61,64 65,68,69,7 2-74,76-80 82-84,89-9 1,93,107,1 08,124,125 134,135,15 8-161,174, 176,178	11/23/87	99/99/99
201114-104	CAP-CER,1000PF,50V,10%,X7R	3	J	68	4.000	1.000	EA	B	Y	N	4.000	0	0	C143,145,1 50,151	00/00/00	99/99/99
201112-220	CAP-CER,220PF,50V,10%	3	E	69	2.000	1.000	EA	B	Y	N	2.000	0	0	C153,164	3/11/87	99/99/99
970085-001	CAP-DM,680PF,300V,1%	3	B	70	1.000	1.000	EA	B	N	N	1.000	0	0	C81	00/00/00	99/99/99
201105-474	CAP-CER,.47MF,50V,10%	3	N	72	1.000	1.000	EA	B	Y	N	3.000	0	0	C85	00/00/00	99/99/99
962003-001	SPEC-8" PWR & GND BUS BAR	1	A	73	1.000	1.000	EA	B	Y	N	1.000	0	0		00/00/00	99/99/99
962002-001	SPEC-15" PWR & GND BUS BAR	1	B	74	1.000	1.000	EA	B	Y	N	1.000	0	0		00/00/00	99/99/99
970551-002	BUS BAR STIFFENER-INSULATED	3	B	75	1.000	1.000	EA	B	Y	N	1.000	0	0		00/00/00	99/99/99
970724-001	DIODE-1N4448,FAST SWITCHING	3	A	87	4.000	1.000	EA	B	Y	N	4.000	0	0	CR18-21	00/00/00	99/99/99
202033	DIODE-RECTIFIER,	3	F	88	2.000	1.000	EA	B	N	N	2.000	0	0	CR14,15	00/00/00	99/99/99
970562-001	DIODE-RECTIFIER,POWER	3	C	89	6.000	1.000	EA	B	Y	N	6.000	0	0	CR6-9,16,1 7	00/00/00	99/99/99
202032-300	DIODE-ZENER	3	C	90	1.000	1.000	EA	B	Y	N	1.000	0	0	CR25	00/00/00	99/99/99
202018-100	DIODE-SWITCHING,1N4148	3	E	91	29.000	1.000	EA	B	Y	N	29.000	0	0	CR12,24,28 -42,49-51, 54,63-65,6 8,71,73-75 ECO#30189	11/23/87	99/99/99
971049-001	DIODE-1N5230B,ZENER,4.7V,5%	3	A	92	1.000	1.000	EA	B	Y	N	1.000	0	0	CR11	5/15/87	99/99/99
202005-500	RECTIFIER-PWR,HI EFF,6A	3	C	93	16.000	1.000	EA	B	N	N	16.000	0	0	CR43-48,52	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

 AS OF 12/30/93

PAGE NO: 4

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,37U
 MODEL:
 ECO NO: 30807
 DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSELETE DATE
202005-500	RECTIFIER-PWR,HI EFF,6A	3 C	93	16.000	1.000	EA	B	N N	16.000	0	0	,53,57-62, 66,67	00/00/00	99/99/99
202011	DIODE-RECTIFIER 1 AMP	3 G	94	1.000	1.000	EA	B	Y N	1.000	0	0	CR13	3/11/87	99/99/99
202009-999	DIODE RECTIFIER,1 AMP	3 D	95	8.000	1.000	EA	B	Y N	8.000	0	0	CR1-4,22,2 3,26,27	3/27/86	99/99/99
202031	DIODE-ZENER	3 E	96	5.000	1.000	EA	B	Y N	5.000	0	0	CR55,56,62 70,72 ECO# 30189	11/23/87	99/99/99
202032	DIODE-ZENER	3 E	98	1.000	1.000	EA	B	N N	1.000	0	0	CR5	00/00/00	99/99/99
970238-001	DIODE-RECTIFIER,DUAL	3 C	99	1.000	1.000	EA	B	N N	1.000	0	0	CR10	00/00/00	99/99/99
202006-100	DIODE-LIGHT EMITTING	3 H	101	1.000	1.000	EA	B	N N	1.000	0	0	DS1	00/00/00	99/99/99
970208-001	CONNECTOR HEADER SOCKET-	3 A	107	1.000	1.000	EA	B	N N	1.000	0	0	J1	00/00/00	99/99/99
970288-001	CONN-HEADER,50 POSN,PIN,	3 B	109	1.000	1.000	EA	B	N N	1.000	0	0	J7	00/00/00	99/99/99
970291-001	CONN-HEADER,8 POSN,PIN,	3 A	110	1.000	1.000	EA	B	N N	1.000	0	0	J8	00/00/00	99/99/99
970581-001	RECTIFIER-.8AMP 60V	3 A	115	1.000	1.000	EA	B	Y N	1.000	0	1	Q1	00/00/00	99/99/99
970563-001	TRANSISTOR-NPN,SILICON	3 A	118	1.000	1.000	EA	B	Y N	1.000	0	0	Q2	00/00/00	99/99/99
970249-001	TRANSISTOR-PNP,SILICON,	3 C	119	1.000	1.000	EA	B	N N	1.000	0	0	Q27	00/00/00	99/99/99
204007-500	TRANSISTOR-NPN SILICON	3 J	120	2.000	1.000	EA	B	Y N	2.000	0	0	Q3,9 ECO#3 0189	11/23/87	99/99/99
970546-001	TRANSISTOR-POWER, MOS FET	3 A	121	4.000	1.000	EA	B	Y N	4.000	0	0	Q18,19,24, 25	12/09/86	99/99/99
204027-037	TRANSISTOR-NPN SILICON	3 E	122	2.000	1.000	EA	B	Y N	2.000	0	0	Q10,11	00/00/00	99/99/99
204027-034	TRANSISTOR-PNP SILICON	3 E	123	4.000	1.000	EA	B	N N	4.000	0	0	Q6,7,13,14	00/00/00	99/99/99
970545-001	TRANSISTOR-POWER, MOS FET	3 A	124	6.000	1.000	EA	B	Y N	6.000	0	0	Q4,5,15,16 21,22	00/00/00	99/99/99
971033-001	TRANS-TIP29B,NPN TO-220	3 B	126	4.000	1.000	EA	B	Y N	4.000	0	0	Q17,20,23, 26	3/16/87	99/99/99
204013-999	TRANSISTOR-NPN SILICON	3 E	127	2.000	1.000	EA	B	Y N	2.000	0	0	Q8,12	3/25/87	99/99/99
200076-100	RES-1.0 MOHM 1/4W 5% CF	3 AC	129	2.000	1.000	EA	F	Y N	2.000	0	0	R177,165	00/00/00	99/99/99
200120-400	RES-4.0 OHM 3.0W 5% WW	3 H	130	1.000	1.000	EA	F	Y N	1.000	0	0	R148	00/00/00	99/99/99
200120-100	RES-1.0 OHM 3.0W 5% WW	3 H	131	1.000	1.000	EA	F	Y N	1.000	0	0	R147	12/09/85	99/99/99
200013-562	RES-5.62 KOHM 1/4W 1% FF	3 R	135	1.000	1.000	EA	F	Y N	1.000	0	0	R268	00/00/00	99/99/99
200013-200	RES-2.0 KOHM 1/4W 1% FF	3 R	136	4.000	1.000	EA	B	N N	5.000	0	0	R77,76,80, 73	00/00/00	99/99/99
200073-100	RES-1.0 KOHM 1/4W 5% CF	3 AC	138	17.000	1.000	EA	F	Y N	17.000	0	0	R52,53,56, 61,86,103, 104,110,16 4,172-176, 245,264,28 1 ECO#3018 9	11/23/87	99/99/99

ORIGINAL

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,37U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R U	ITEM NO.	QTY ASSEMBLY	PER YIELD FACTR	UM	SC	R E P Q	P F Q	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200013-634	RES-6.34 KOHM 1/4W 1% FF	3	R	139	1.000	1.000	EA	F	N	N	1.000	0	0	R265	00/00/00	99/99/99
200013-100	RES-1.00 KOHM 1/4W 1% FF	3	R	140	6.000	1.000	EA	F	N	N	6.000	0	0	R15,70,78, 89,90,91	00/00/00	99/99/99
200073-470	RES-4.7 KOHM 1/4W 5% CF	3	AC	141	12.000	1.000	EA	F	Y	N	12.000	0	0	R64,66,69, 163,182,23 0,232,234, 236,261,26 2,272	2/21/86	99/99/99
200015-100	RES-100 KOHM 1/4W 1% FF	3	R	142	4.000	1.000	EA	F	Y	N	4.000	0	0	R125,129,1 34,137	12/09/85	99/99/99
200016-100	RES-1.00 MOHM 1/8W 1% FF	3	R	143	1.000	1.000	EA	F	Y	N	1.000	0	0	R109	00/00/00	99/99/99
200013-499	RES-4.99 KOHM 1/4W 1% FF	3	R	144	6.000	1.000	EA	F	N	N	6.000	0	0	R83,84,94, 95,241,258	00/00/00	99/99/99
200072-390	RES-390 OHM 1/4W 5% CF	3	AC	145	6.000	1.000	EA	F	Y	N	6.000	0	0	R41,49,184 ,225,226,2 79	00/00/00	99/99/99
200071-820	RES-82 OHM 1/4W 5% CF	3	AC	146	1.000	1.000	EA	F	N	N	1.000	0	0	R48	00/00/00	99/99/99
200013-221	RES-2.21 KOHM 1/4W 1% FF	3	R	147	2.000	1.000	EA	F	N	N	2.000	0	0	R74,75	00/00/00	99/99/99
971030-010	RES-FUSIBLE .1 OHM 2W+5%	3	A	148	8.000	1.000	EA	B	Y	N	8.000	0	0	R185,186,1 88,189,206 207,209,21 0	3/16/87	99/99/99
970536-047	RES-47 OHM,2W,5%,CF,FIXED	3	C	149	2.000	1.000	EA	B	Y	N	2.000	0	0	R187,208	00/00/00	99/99/99
200014-402	RES-40.2 KOHM 1/4W 1% FF	3	R	150	4.000	1.000	EA	F	Y	N	12.000	0	0	R112,113,1 39,140	00/00/00	99/99/99
200013-402	RES-4.02 KOHM 1/4W 1% FF	3	R	151	1.000	1.000	EA	B	Y	N	1.000	0	0	R14	11/21/85	99/99/99
200013-249	RES-2.49 KOHM 1/4W 1% FF	3	R	152	1.000	1.000	EA	F	N	N	1.000	0	0	R82	00/00/00	99/99/99
200073-220	RES-2.2 KOHM 1/4W 5% CF	3	AC	153	3.000	1.000	EA	F	N	N	3.000	0	0	R81,106,18 0	00/00/00	99/99/99
200014-562	RES-56.2 KOHM 1/4W 1% FF	3	R	154	2.000	1.000	EA	B	Y	N	2.000	0	0	R121,124	12/12/85	99/99/99
200072-330	RES-330 OHM 1/4W 5% CF	3	AC	155	6.000	1.000	EA	F	Y	N	6.000	0	0	R35,05,116 117,143,14 4	00/00/00	99/99/99
200073-270	RES-2.7 KOHM 1/4W 5% CF	3	AC	156	6.000	1.000	EA	F	Y	N	6.000	0	0	R13,57,58, 60,68,183 ECO#30189	11/23/87	99/99/99
200071-200	RES-20 OHM 1/4W 5% CF	3	AC	157	3.000	1.000	EA	F	Y	N	3.000	0	0	R10,11,55	00/00/00	99/99/99
200071-510	RES-51 OHM 1/4W 5% CF	3	AC	158	1.000	1.000	EA	F	Y	N	1.000	0	0	R38	00/00/00	99/99/99
200073-150	RES-1.5 KOHM 1/4W 5% CF	3	AC	159	5.000	1.000	EA	F	Y	N	5.000	0	0	R44,46,50 51,65	00/00/00	99/99/99
200073-510	RES-5.1 KOHM 1/4W 5% CF	3	AC	160	10.000	1.000	EA	F	Y	N	10.000	0	0	R45,47,157	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 6

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,37U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200073-510	RES-5.1 KOHM 1/4W 5% CF	3	AC	160	10.000	1.000	EA	F	Y N	10.000	0	0	,158,161,1 62,192,201 213,221	00/00/00	99/99/99
200082-120	RES-120 OHM 1/2W 5% CF	3	L	161	2.000	1.000	EA	B	N N	2.000	0	0	R3,4	00/00/00	99/99/99
200071-470	RES-47 OHM 1/4W 5% CF	3	AC	163	4.000	1.000	EA	F	Y N	4.000	0	0	R197,205,2 27,228	00/00/00	99/99/99
200122-750	RES-750 OHM 3.0W 5% WW	3	H	164	1.000	1.000	EA	F	Y N	1.000	0	0	R2	3/11/87	99/99/99
200093-270	RES-2.7 KOHM 1W 5% FC	3	A	165	2.000	1.000	EA	F	Y N	2.000	0	0	R6,253	12/09/85	99/99/99
970271-002	RES-20 OHM 2W 5% FC	3	A	166	2.000	1.000	EA	B	N N	2.000	0	0	R62,63	00/00/00	99/99/99
200070-560	RES-5.6 OHM 1/4W 5% CF	3	AC	167	2.000	1.000	EA	F	N N	2.000	0	0	R150,149	00/00/00	99/99/99
200074-100	RES-10 KOHM 1/4W 5% CF	3	AC	168	17.000	1.000	EA	F	Y N	17.000	0	0	R7,8,23,34 54,67,111, 120,130,13 8,153,154, 169,194,20 0,215,220	00/00/00	99/99/99
200014-619	RES-61.9 KOHM 1/4W 1% FF	3	R	169	2.000	1.000	EA	B	Y N	2.000	0	0	R128,133	12/12/85	99/99/99
200074-220	RES-22 KOHM 1/4W 5% CF	3	AC	170	2.000	1.000	EA	F	N N	2.000	0	0	R105,181	00/00/00	99/99/99
200013-750	RES-7.50 KOHM 1/4W 1% FF	3	R	171	1.000	1.000	EA	F	Y N	1.000	0	0	R263	00/00/00	99/99/99
200074-560	RES-56 KOHM 1/4W 5% CF	3	AC	172	2.000	1.000	EA	F	Y N	2.000	0	0	R239,256	3/11/87	99/99/99
200073-360	RES-3.6 KOHM 1/4W 5% CF	3	AC	173	4.000	1.000	EA	F	Y N	4.000	0	0	R237,238,2 54,255	00/00/00	99/99/99
971416-750	RES-7.5 OHM,5%,1W,CF	3	A	174	2.000	1.000	EA	F	Y N	2.000	0	0	R42,R43 ECO#30807	9/06/88	99/99/99
200072-430	RES-430 OHM 1/4W 5% CF	3	AC	175	2.000	1.000	EA	F	Y N	2.000	0	0	R166,178	00/00/00	99/99/99
200074-120	RES-12 KOHM 1/4W 5% CF	3	AC	176	1.000	1.000	EA	F	Y N	1.000	0	0	R168	2/21/86	99/99/99
200013-301	RES-3.01 KOHM 1/4W 1% FF	3	R	177	4.000	1.000	EA	F	Y N	4.000	0	0	R36,37,39, 71	00/00/00	99/99/99
200072-220	RES-220 OHM 1/4W 5% CF	3	AC	178	3.000	1.000	EA	F	Y N	3.000	0	0	R96,102,24 6	00/00/00	99/99/99
200013-147	RES-1.47 KOHM 1/4W 1% FF	3	R	179	2.000	1.000	EA	F	Y N	2.000	0	0	R259,242	12/09/85	99/99/99
200013-432	RES-4.32 KOHM 1/4W 1% FF	3	R	180	4.000	1.000	EA	F	Y N	4.000	0	0	R126,127,1 35,136	12/09/85	99/99/99
200081-620	RES-62 OHM 1/2W 5% CF	3	L	181	1.000	1.000	EA	B	Y N	1.000	0	0	R33	4/02/87	99/99/99
200075-100	RES-100 KOHM 1/4W 5% CF	3	AC	182	7.000	1.000	EA	F	Y N	7.000	0	0	R24-26,31, 260,273,27 6	00/00/00	99/99/99
200072-100	RES-100 OHM 1/4W 5% CF	3	AC	183	4.000	1.000	EA	F	Y N	4.000	0	0	R159,160,2 67,277	00/00/00	99/99/99
200075-220	RES-220 KOHM 1/4W 5% CF	3	AC	184	1.000	1.000	EA	F	Y N	1.000	0	0	R271	00/00/00	99/99/99
200072-470	RES-470 OHM 1/4W 5% CF	3	AC	185	5.000	1.000	EA	F	Y N	5.000	0	0	R27,249,25	00/00/00	99/99/99

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERV0,37U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	RU	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q	F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200072-470	RES-470 OHM 1/4W 5% CF	3	AC	185	5.000	1.000	EA	F	Y	N	5.000	0	0	0,252,280	00/00/00	99/99/99
200074-330	RES-33 KOHM 1/4W 5% CF	3	AC	186	3.000	1.000	EA	F	N	N	3.000	0	0	R32,98,99	00/00/00	99/99/99
200076-470	RES-4.7 MOHM 1/4W 5% CF	3	AC	187	1.000	1.000	EA	F	N	N	1.000	0	0	R100	00/00/00	99/99/99
200072-200	RES-200 OHM 1/4W 5% CF	3	AC	188	6.000	1.000	EA	F	Y	N	6.000	0	0	R22,179,19 6,198,217, 218 ECO#30 189	11/23/87	99/99/99
200071-150	RES-15 OHM 1/4W 5% CF	3	AC	189	1.000	1.000	EA	F	N	N	1.000	0	0	R21	00/00/00	99/99/99
200072-150	RES-150 OHM 1/4W 5% CF	3	AC	190	1.000	1.000	EA	F	Y	N	1.000	0	0	R152	12/11/85	99/99/99
970969-047	RES-FUSIBLE,470HM,1/2W,5% MF	3	C	191	6.000	1.000	EA	B	Y	N	6.000	0	0	R19,20,193 202,214,22 2	3/16/87	99/99/99
200015-200	RES-200 KOHM 1/4W 1% FF	3	R	192	4.000	1.000	EA	B	Y	N	4.000	0	0	R122,123,1 31,132	11/06/85	99/99/99
200074-470	RES-47 KOHM 1/4W 5% CF	3	AC	193	3.000	1.000	EA	F	Y	N	3.000	0	0	R171,243,2 70	00/00/00	99/99/99
200071-120	RES-12 OHM 1/4W 5% CF	3	AC	194	1.000	1.000	EA	F	N	N	1.000	0	0	R151	00/00/00	99/99/99
200013-475	RES-4.75 KOHM 1/4W 1% FF	3	R	195	2.000	1.000	EA	F	N	N	2.000	0	0	R266,269	00/00/00	99/99/99
200014-169	RES-16.9 KOHM 1/4W 1% FF	3	R	196	1.000	1.000	EA	B	N	N	1.000	0	0	R274	00/00/00	99/99/99
200073-300	RES-3 KOHM 1/4W 5% CF	3	AC	197	2.000	1.000	EA	F	Y	N	2.000	0	0	R248,251	00/00/00	99/99/99
200073-110	RES-1.1 KOHM 1/4W 5% CF	3	AC	198	1.000	1.000	EA	F	Y	N	1.000	0	0	R156	12/11/85	99/99/99
200073-680	RES-6.8 KOHM 1/4W 5% CF	3	AC	200	5.000	1.000	EA	F	N	N	6.000	0	0	R12,229,23 1,233,235	00/00/00	99/99/99
200074-110	RES-11 KOHM 1/4W 5% CF	3	AC	201	1.000	1.000	EA	F	Y	N	1.000	0	0	R155 ECO#30189	11/23/87	99/99/99
970537-002	RES-100 OHM 5% 5W WW	3	A	202	1.000	1.000	EA	B	Y	N	1.000	0	0	R5	00/00/00	99/99/99
200076-130	RES-1.3 MOHM 1/4W 5% CF	3	AC	203	1.000	1.000	EA	F	Y	N	1.000	0	0	R170	12/09/86	99/99/99
200071-100	RES-10 OHM 1/4W 5% CF	3	AC	204	4.000	1.000	EA	F	Y	N	4.000	0	0	R195,199,2 16,219	00/00/00	99/99/99
200148-100	RES-0.10 OHM 6.5W 5% WW	3	D	205	1.000	1.000	EA	F	N	N	1.000	0	0	R278	00/00/00	99/99/99
200074-390	RES-39 KOHM 1/4W 5% CF	3	AC	206	1.000	1.000	EA	F	N	N	1.000	0	0	R17	00/00/00	99/99/99
200073-390	RES-3.9 KOHM 1/4W 5% CF	3	AC	207	2.000	1.000	EA	F	Y	N	2.000	0	0	R18	00/00/00	99/99/99
200014-909	RES-90.9 KOHM 1/4W 1% FF	3	R	208	1.000	1.000	EA	F	N	N	1.000	0	0	R79	00/00/00	99/99/99
200011-100	RES-10.0 OHM 1/4W 1% FF	3	R	209	1.000	1.000	EA	B	Y	N	1.000	0	0	R16	11/21/85	99/99/99
200013-806	RES-8.06 KOHM 1/4W 1% FF	3	R	210	1.000	1.000	EA	F	N	N	1.000	0	0	R30	00/00/00	99/99/99
200014-100	RES-10.0 KOHM 1/4W 1% FF	3	R	211	5.000	1.000	EA	F	Y	N	4.000	0	0	R28,29,93, 240,257	00/00/00	99/99/99
200013-681	RES-6.81 KOHM 1/4W 1% FF	3	R	212	1.000	1.000	EA	F	Y	N	1.000	0	0	R275	00/00/00	99/99/99
200073-200	RES-2 KOHM 1/4W 5% CF	3	AC	213	3.000	1.000	EA	F	Y	N	3.000	0	0	R59,97,244 ECO#30189	11/23/87	99/99/99
200012-200	RES-200 OHM 1/4W 1% FF	3	R	214	1.000	1.000	EA	B	N	N	1.000	0	0	R92	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERVO,37U
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	UM	SC	R E P Q	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970568-201	RES-200 OHM 1W 5% CF	3	D	215	8.000	1.000	EA	B	Y	N	8.000	0	0 R190,191,2 03,204,211 212,223,22 4 ECO#3018 9	11/23/87 99/99/99
200072-680	RES-680 OHM 1/4W 5% CF	3	AC	216	10.000	1.000	EA	F	Y	N	10.000	0	0 R107,114,1 15,118,119 141,142,14 5,146,167 ECO#30189	11/23/87 99/99/99
200073-330	RES-3.3 KOHM 1/4W 5% CF	3	AC	217	1.000	1.000	EA	F	N	N	1.000	0	0 R108	00/00/00 99/99/99
200076-180	RES-1.8 MOHM 1/4W 5% CF	3	AC	218	1.000	1.000	EA	B	N	N	1.000	0	0 R101	00/00/00 99/99/99
200012-750	RES-750 OHM 1/4W 1% FF	3	R	219	2.000	1.000	EA	B	N	N	2.000	0	0 R87,88	00/00/00 99/99/99
200073-620	RES-6.2 KOHM 1/4W 5% CF	3	AC	220	3.000	1.000	EA	F	Y	N	3.000	0	0 R1,9,247	2/21/86 99/99/99
200014-536	RES-53.6 KOHM 1/4W 1% FF	3	R	221	1.000	1.000	EA	F	Y	N	1.000	0	0 R40	12/09/85 99/99/99
205248-200	RES-NTWK 4.7 KOHM DIP	3	B	222	1.000	1.000	EA	B	Y	N	1.000	0	0 U12DA	5/19/86 99/99/99
970843-001	RES-NET-SIP,220 OHM,ISOL	3	B	223	2.000	1.000	EA	B	Y	N	2.000	0	0 RP1,RP2	5/19/86 99/99/99
200083-100	RES-1.0 KOHM 1/2W 5% CF	3	L	224	1.000	1.000	EA	F	Y	N	1.000	0	0 R282 ECO#3 0189	11/23/87 99/99/99
970267-001	PIN-TEST,.040SQ X .360LG	3	A	245	39.000	1.000	EA	F	Y	N	39.000	0	0 TP1-39 ECO #30189	11/23/87 99/99/99
970989-001	IC-74ALS05,INVERTER,OPEN COLTR	3	A	249	1.000	1.000	EA	B	Y	N	1.000	0	0 U7D	3/12/87 99/99/99
203007-700	IC-339 VOLT COMP QUAD	3	J	250	6.000	1.000	EA	B	N	N	6.000	0	0 U4D,10J,11 L,12J,12K, 13R	00/00/00 99/99/99
970554-001	IC-3525 MOD PULSE WIDT	3	C	251	1.000	1.000	EA	B	Y	N	1.000	0	0 U4F	00/00/00 99/99/99
203052-051	IC-4051 MUX 8 CH	3	C	252	2.000	1.000	EA	B	N	N	2.000	0	0 U8C,9E	00/00/00 99/99/99
970025-001	IC-556 TIMER DUAL	3	C	253	1.000	1.000	EA	B	Y	N	1.000	0	0 U4C	00/00/00 99/99/99
203130-999	IC-082 OP AMP JFET IN	3	F	254	4.000	1.000	EA	B	N	N	4.000	0	0 U8B,8D,9A, 9C	00/00/00 99/99/99
203550-501	IC-1001 CONV A-D 10BIT 170NS	3	E	255	1.000	1.000	EA	B	Y	N	1.000	0	0 U10CB	00/00/00 99/99/99
970454-001	IC-7533 CONV D-A 10BIT	3	C	256	1.000	1.000	EA	B	N	N	1.000	0	0 U10AA	00/00/00 99/99/99
203082-500	IC-7407N BUF DRV HEX	3	E	258	2.000	1.000	EA	B	N	N	2.000	0	0 U9J,10EA	00/00/00 99/99/99
203012-136	IC-4136 OP AMP QUAD	3	J	259	3.000	1.000	EA	B	N	N	3.000	0	0 U7J,11M,11 P	00/00/00 99/99/99
203555-111	IC-8036 CIO 16BIT 6MHZ	3	C	265	2.000	1.000	EA	B	N	N	2.000	0	0 U11B,12B	00/00/00 99/99/99
970010-001	IC-74LS08 AND 2IN QUAD	3	B	266	3.000	1.000	EA	B	N	N	3.000	0	0 U11C,11D,1 2DB	00/00/00 99/99/99
203085-001	IC-74LS14 INV SCHMITT HEX	3	J	267	1.000	1.000	EA	B	Y	N	1.000	0	0 U11F	00/00/00 99/99/99
203029-003	IC-74LS11 AND 3IN TRIP	3	F	269	2.000	1.000	EA	B	N	N	2.000	0	0 U10KA,10KB	00/00/00 99/99/99
203039-001	IC-74LS74 FF D DUAL	3	M	270	1.000	1.000	EA	B	N	N	1.000	0	0 U11R	00/00/00 99/99/99

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY
963491-001 OPCODE: 4 REV: E PWB ASSY-SENSOR SERV0,370
MODEL:
ECO NO: 30807
DATE OF LAST ECO: 9/07/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

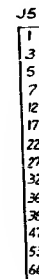
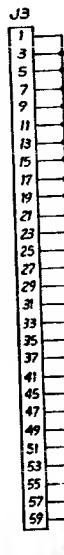
PART NUMBER	DESCRIPTION	O P	ITEM RV	QTY NO.	PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970221-001	IC-74LS00 NAND 2IN POS QUAD	3	E	272	1.000	1.000	EA	B	N	N	1.000	0	0 U12CB	00/00/00 99/99/99
203046-001	IC-74LS123 MLTV DUAL	3	G	273	2.000	1.000	EA	B	N	N	2.000	0	0 U13M,13P	00/00/00 99/99/99
203051-100	IC-74LS175 FF D QUAD	3	G	274	2.000	1.000	EA	B	N	N	2.000	0	0 U10BA,13D	00/00/00 99/99/99
731006-800	LABEL-ASSY	3	B	278	1.000	1.000	EA	F	N	N	1.000	0	0	00/00/00 99/99/99
203046-148	IC-74LS138 DCDR 3-8 LINE	3	K	279	1.000	1.000	EA	B	N	N	1.000	0	0 U10CA	00/00/00 99/99/99
203035-032	IC-74LS32 OR 2IN QUAD	3	J	280	1.000	1.000	EA	B	N	N	1.000	0	0 U10F	00/00/00 99/99/99
203029-500	IC-7414 INV HEX SCHMITT TRIP,	3	C	281	1.000	1.000	EA	B	N	N	1.000	0	0 U7E	00/00/00 99/99/99
203052-378	IC-74LS378 FF D HEX	3	D	282	2.000	1.000	EA	B	N	N	2.000	0	0 U10AB,10BB	00/00/00 99/99/99
203051-174	IC-74LS174,FF,D,HEX	3	L	283	2.000	1.000	EA	B	Y	N	2.000	0	0 U12CA,13C	00/00/00 99/99/99
970011-001	IC-74LS04 INV HEX	3	D	284	1.000	1.000	EA	B	N	N	1.000	0	0 U10EB	00/00/00 99/99/99
203052-244	IC-74LS244 BFR OCT 3S	3	L	285	1.000	1.000	EA	B	N	N	1.000	0	0 U13B	00/00/00 99/99/99
203013-317	IC-78L05 VOLT REG +5V 5%	3	E	296	1.000	1.000	EA	B	N	N	1.000	0	0 UR5	00/00/00 99/99/99
203013-210	IC-7812 VOLT REG -12V 1A	3	F	297	1.000	1.000	EA	B	N	N	1.000	0	0 UR2	00/00/00 99/99/99
203013-300	IC-7912 VOLT REG,12V,1.5AMPS	3	L	298	1.000	1.000	EA	B	N	N	1.000	0	0 UR3	00/00/00 99/99/99
970002-001	IC-7906 VOLT REG -6V	3	A	300	1.000	1.000	EA	B	N	N	1.000	0	0 UR1	00/00/00 99/99/99
970255-001	IC-7808 VOLT REG +8V 1A	3	B	301	1.000	1.000	EA	B	N	N	1.000	0	0 UR4	00/00/00 99/99/99
203009-005	IC-084 OP AMP BIFET	3	F	307	1.000	1.000	EA	B	Y	N	1.000	0	0 U12F	12/09/86 99/99/99
209990-071	ADHESIVE-SUPERBONDER	3	C	308	0.000	1.000	EA	F	Y	N	0.000	0	0	11/22/85 99/99/99
213020-605	SCREW- 6-32X5/16,BDR HD,SLOT	3	A	309	1.000	1.000	EA	F	Y	N	1.000	0	0	3/27/86 99/99/99
213700-609	WASHER-FLAT,NYLON,SM PAT	3	C	310	1.000	1.000	EA	F	Y	N	1.000	0	0	12/04/85 99/99/99
970559-001	NUT-ACORN CAP 6-32 NYLON	3	A	311	1.000	1.000	EA	B	Y	N	1.000	0	0	12/04/85 99/99/99
209990-063	ADHESIVE-DOW CORNING 3145	3	A	312	.001	1.000	EA	F	Y	N	.001	0	0 ECO#30708	6/23/88 99/99/99
970548-002	RELAY-DPDT,7.5 AMP,12V,PC	3	C	313	1.000	1.000	EA	B	Y	N	1.000	0	0 K1	3/12/87 99/99/99
971041-001	LABEL-BAR CODE,1.425LX.25W,9.*	3	B	315	1.000	1.000	EA	F	Y	N	1.000	0	0	00/00/00 99/99/99
965042-001	LABEL-CAUTION	3	A	316	1.000	1.000	EA	F	Y	N	1.000	0	0 ECO#30243	1/27/88 99/99/99

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. IC VCC & GND PINS WITH UNUSED PORTIONS:

IC TYPE	REFERENCE DESIGNATOR	VCC	GND	UNUSED
SN74LS00N	16A, 18A, 22D, 25E	14	7	
SN74LS01N	23H	14	7	C
SN74LS04N	23C, 12A	14	7	27H-D
SN74LS08N	22E, 27H	14	7	
SN74LS10N	18B, 19B	14	7	24L-D
SN74LS11N	14D, 6A	14	7	E, F
SN74LS14N	3D	14	7	
SN74LS20N	22H	14	7	
SN74LS32N	17D, 20D, 20J, 25H, 13H	14	7	
SN74LS42N	23D, 23A	16	8	
SN74LS74N	15L, 16E, 16L, 17F, 18D, 22C	14	7	22C-A
SN74LS174N	14A	16	8	
SN74LS109N	20C	16	8	
SN74LS125N	20H	16	8	
SN74LS138N	27J	16	8	
SN74LS139N	27E	16	8	
SN74LS153N	17H, 18D, 18F	16	8	
SN74LS244N	38, 6D, 9B, 9C, 12D, 16C, 22B, 27B	20	10	16C-A 38-G, 27A-C, E, G
SN74LS245N	23B, 25B	20	10	
SN74LS256N	14J	16	8	
SN74LS280N	22J, 23J	14	7	
SN74LS374N	17K, 17L, 17N	20	10	
74S112PC	16J	16	8	
DM74S125N	18J	16	8	
74S280N	6C, 9D	14	7	U16B-B, C, D
74F32	U16B	14	7	
74F00PC	15H	14	7	
74F04PC	17J	14	7	B, C, D
74F08PC	3C	14	7	15K-B
74F74PC	12C, 15K, 16L, 17E, 23E	14	7	
74F86PC	14	14	7	
74F109PC	15D, 16D	16	8	15B-B
74F138PC	16H	16	8	
74F191PC	16F	20	10	
74F373PC	22F, 27F	20	10	
74F374PC	6B, 6J, 9J	20	10	
2712B	20K, 22K, 23K, 25K,	28	14	
AN2901CPC	3K, 6K, 9K, 12K, 14K	10	30	
AN2947PC	23F, 25F	20	10	
AN2966PC	3J, 12J, 15E, 15F, 16H, 27H, 27P	20	10	15E-A, C, E, G
16C164AN	1E, 2E, 4E, 5E, 7E, 8E, 10E, 11E, 13E, 14E, 15E, 16E, 17E, 18E, 19E, 20E, 21E, 22E, 23E, 24E, 25E, 26E, 27E, 28E, 29E, 30E, 31E, 32E, 33E, 34E, 35E, 36E, 37E, 38E, 39E, 40E, 41E, 42E, 43E, 44E, 45E, 46E, 47E, 48E, 49E, 50E, 51E, 52E, 53E, 54E, 55E, 56E, 57E, 58E, 59E, 60E	8	16	
K2210D	25J	16	8	
Z8002APS	25C	16	8	
Z8036APS	20E, 20W	28	7	
Z8501PS	27D, 11C	5	14	
LM1391N	14N	-	1	
19L20L10	15A, 17A, 17A	24	12	
19L20L10	16A	24	12	
19L20L10	16A (RESISTOR NETWORK)	16	8	16A 5.6, 7, 14

2. POWER & GND ON CONNECTORS:



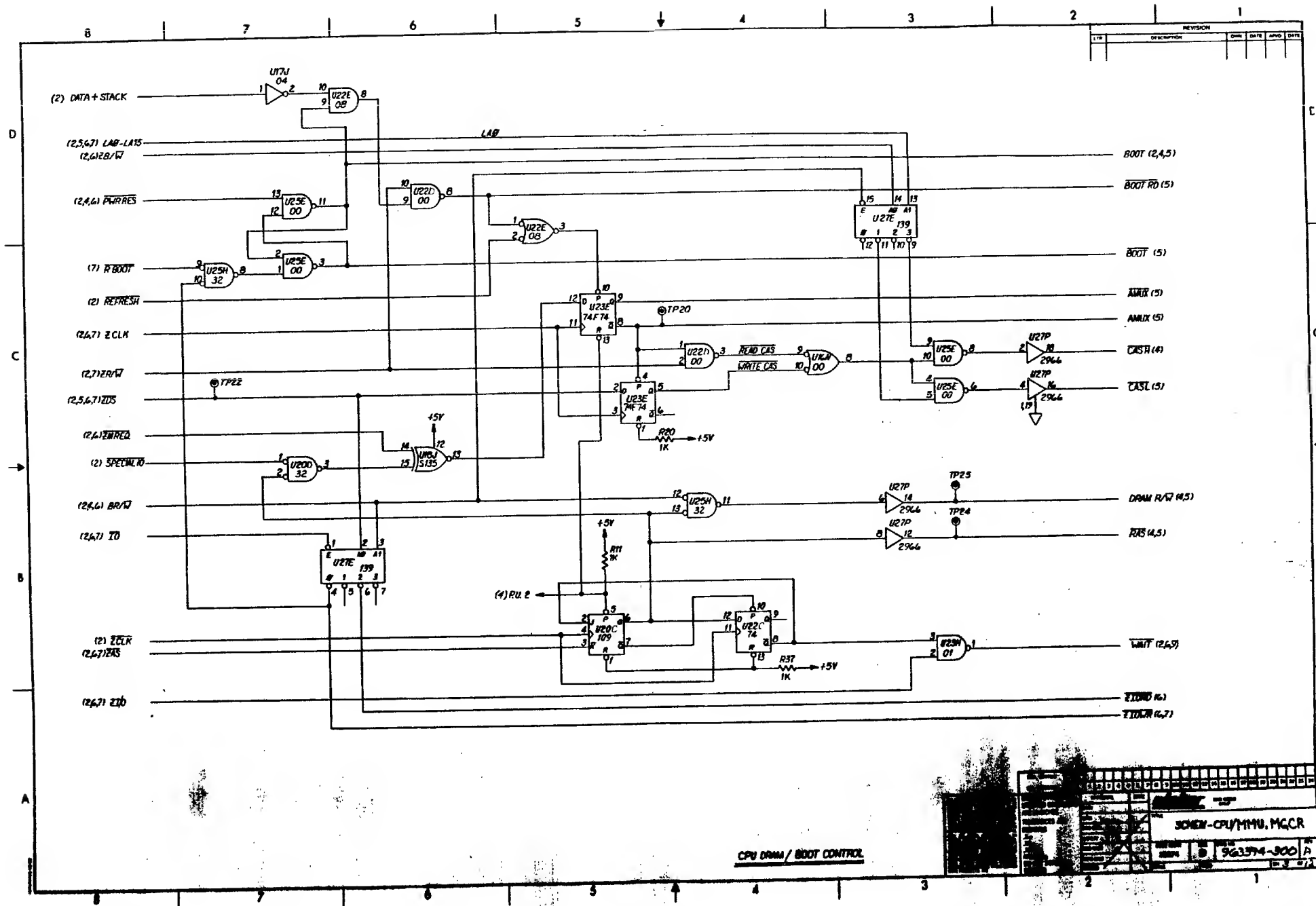
TP27-TP31

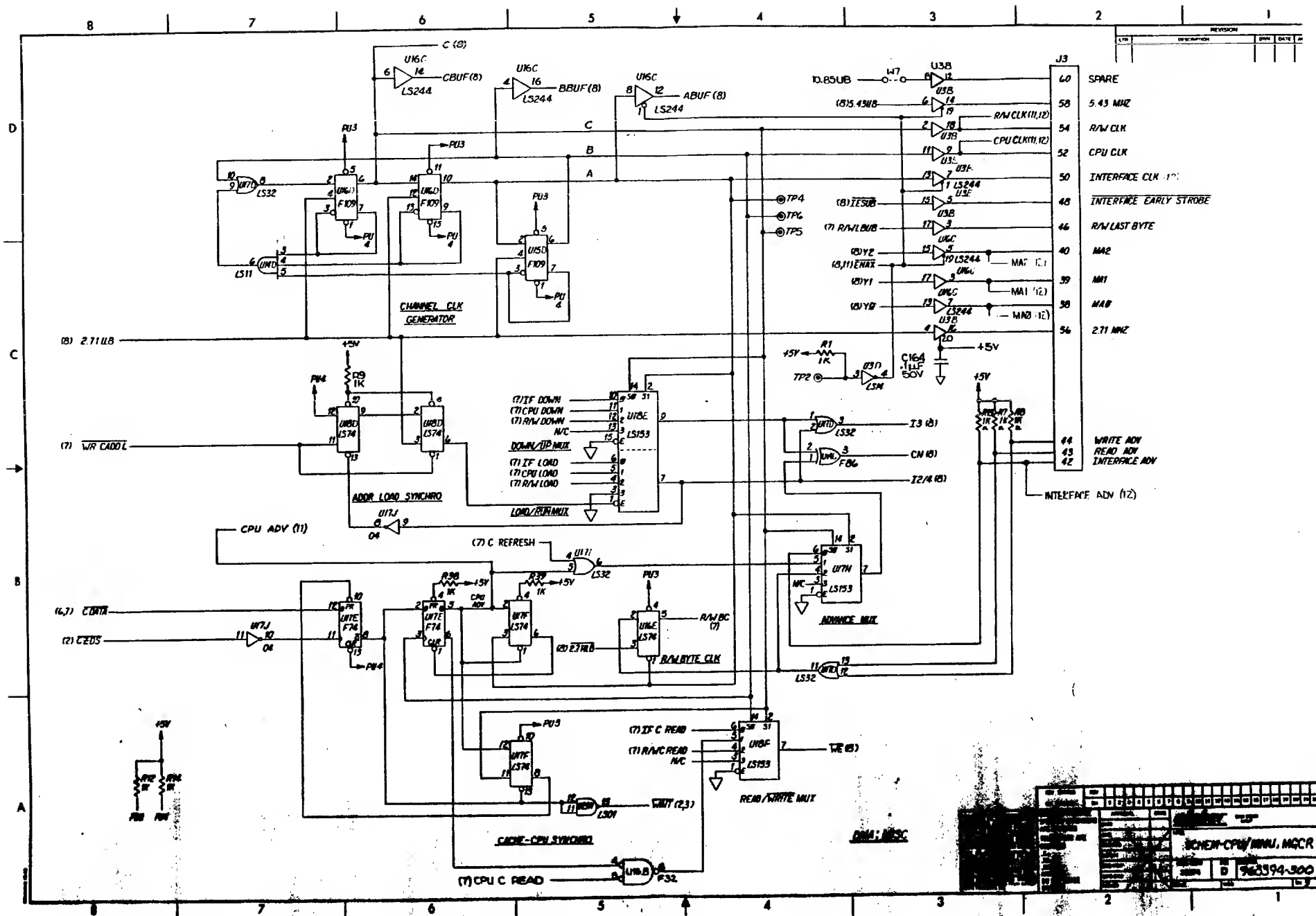
3.

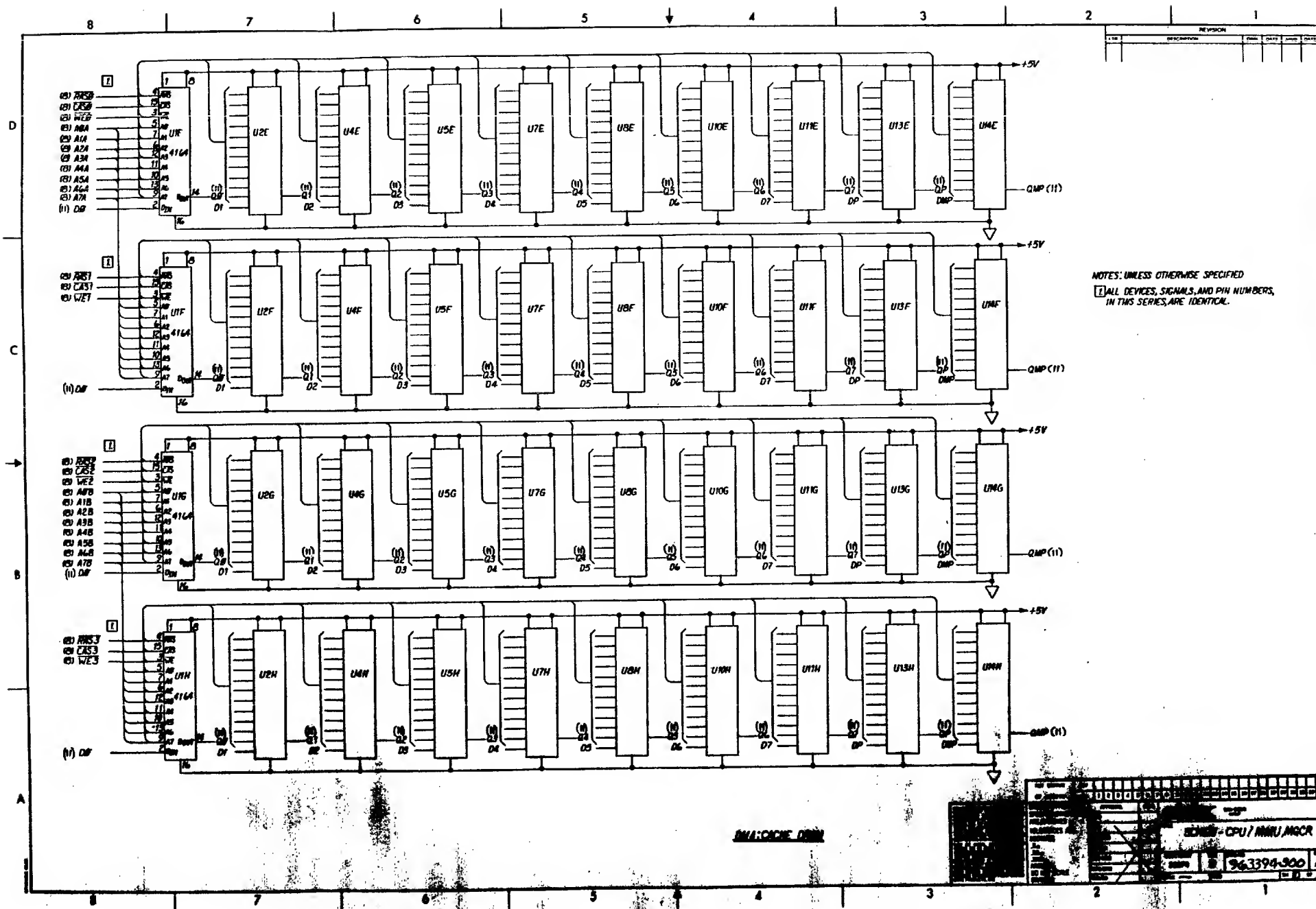
REFERENCE DESIGNATOR				
LTR	LAST USED	NOT USED	LTR	LAST USED
C	163		TP	34
CR	1		Y	1
P	5	1, 2	U	27P
Q	2			
R	47	27, 28, 32, 40		

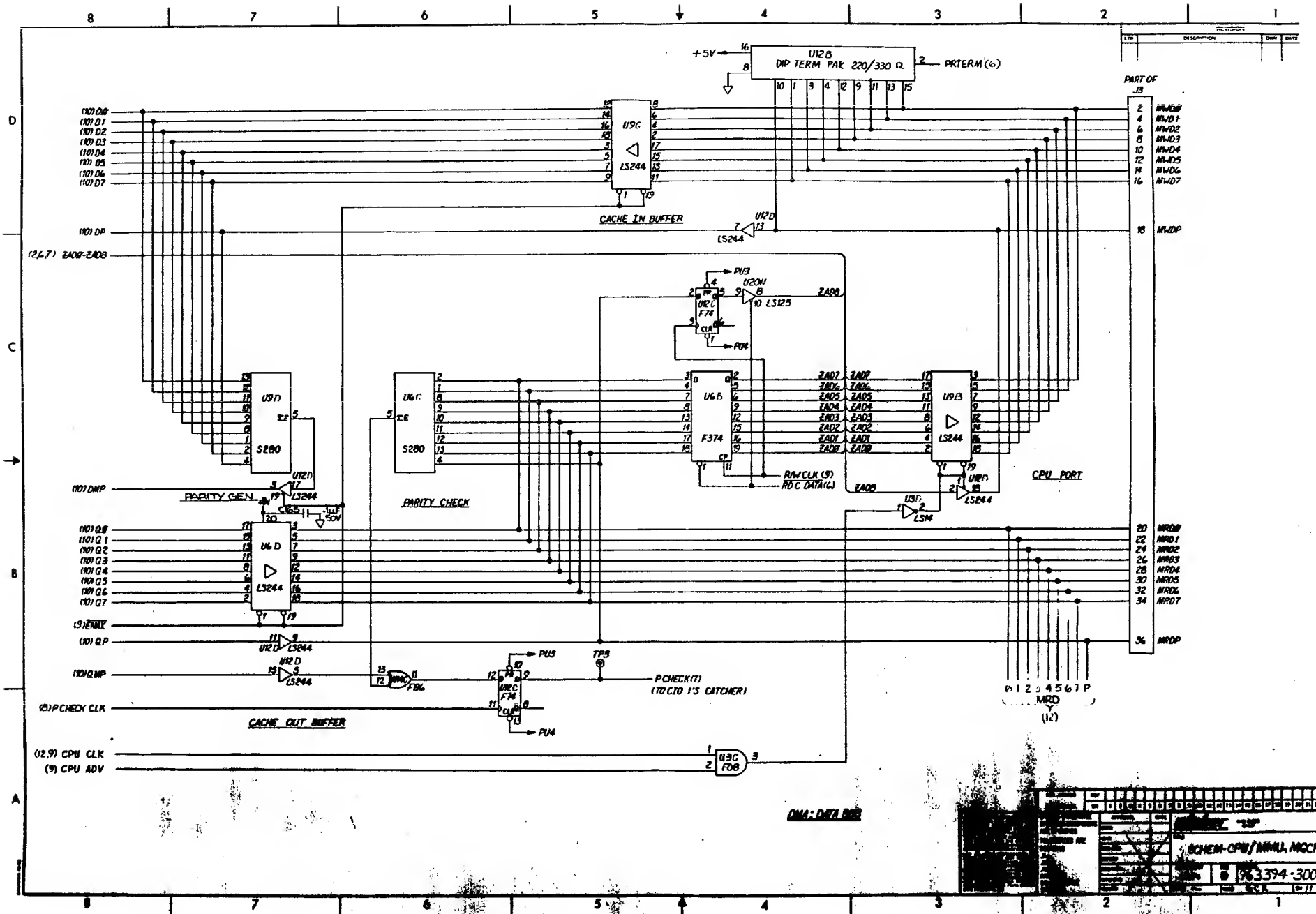
4. RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
5. OPTIONAL COMPONENTS ARE LISTED IN THE BOM.

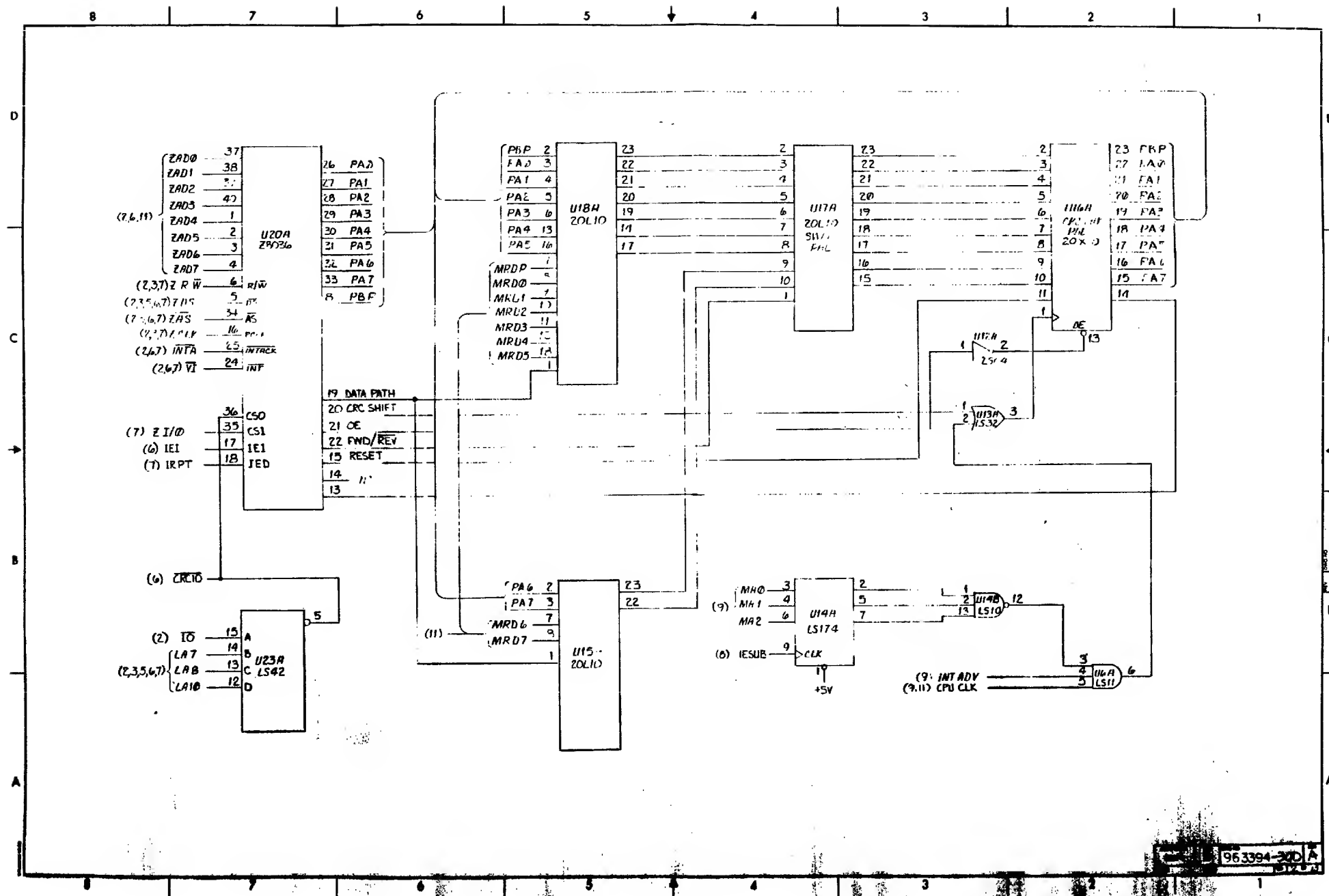


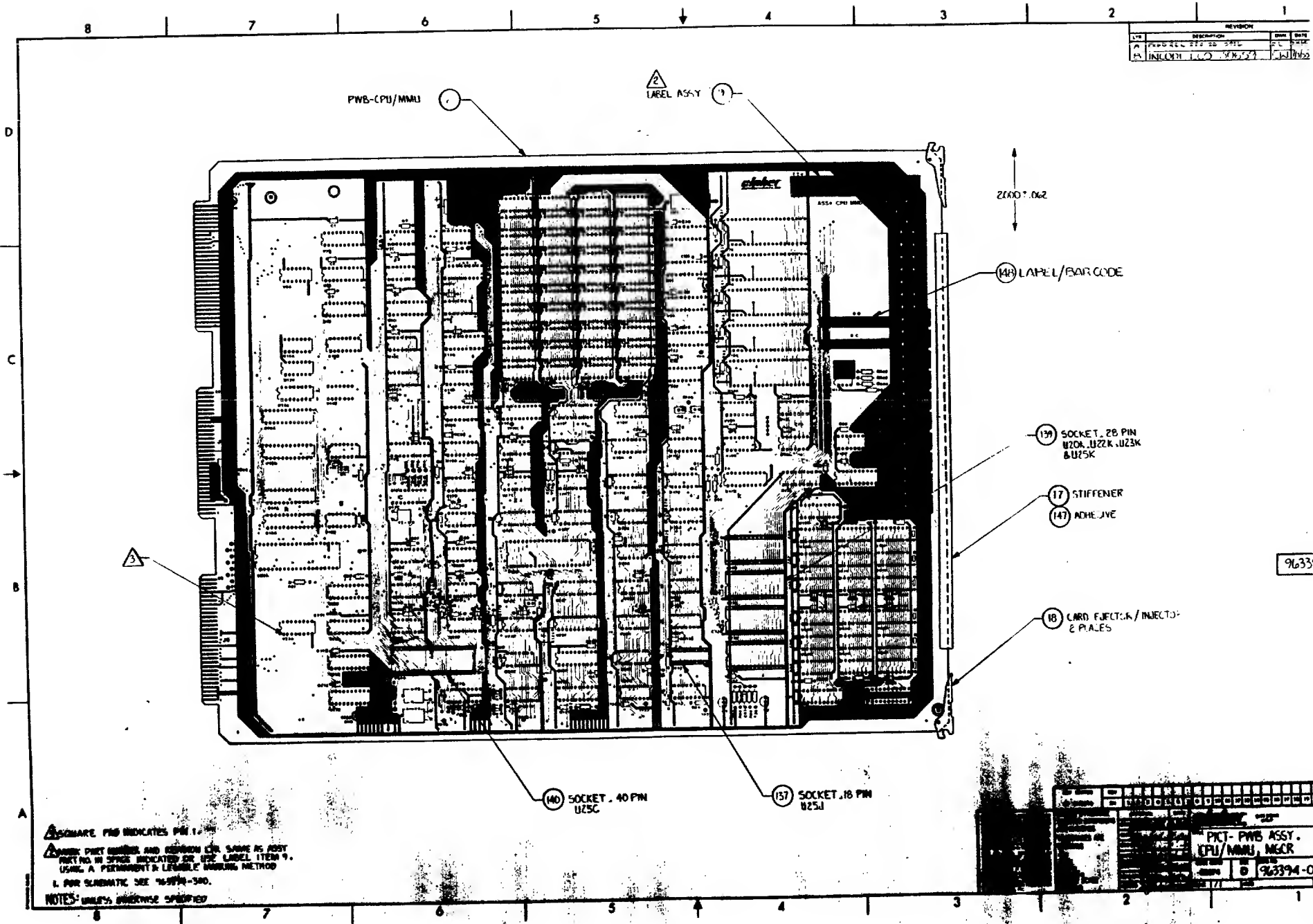












REV	DESCRIPTION	DATE	BY
A	PRODUCED TO 20 000	01 01 00	01 01 00
B	INCL. 1.00 000 000	01 01 00	01 01 00

96339

PCT - PWB ASSY.	
CPU/MMU, MEGR	
Q	963394-000

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.P. UNIQUE BOARD ASSY

963394-002 OPCODE: 4 REV: A PWB ASSY-CPU/MMU MGR
MODEL:
ECO NO:
DATE OF LAST ECO: 00/00/00

OP: OPDEP POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	Q P	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTP	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
965483-000	PICT-PWB ASSY. CPU/MMU. MGR	0 A	1	0.000	1.000	EA	F	N N	0.000	0	0	00/00/00	99/99/99
963394-101	PWB-CPU/MMU.MGR	1 B	2	1.000	1.000	EA	B	Y N	1.000	0	0	00/00/00	99/99/99
965483-300	SCHEM-CPU/MMU. MGR	0 A	3	0.000	1.000	EA	F	Y N	0.000	0	0	00/00/00	99/99/99
731006-800	LABEL-ASSY	3 B	9	1.000	1.000	EA	F	N N	1.000	0	0	00/00/00	99/99/99
961707-002	STIFFENER-EDGE.PCB	3 B	17	1.000	1.000	EA	B	Y N	1.000	0	0	00/00/00	99/99/99
970083-001	INJECTOR/EJECTOR-1/16"	3 B	18	2.000	1.000	EA	B	N N	2.000	0	0	00/00/00	99/99/99
201191-063	CAP-ELEC.22MF.6.3V.-10+50%.AL	3 H	25	5.000	1.000	EA	B	Y N	5.000	0	0	C.8.35.48. 85.122	00/00/00 99/99/99
970784-104	CAP-CER..1UF.50V.-20+80%.AX.*	3 E	26	157.000	1.000	EA	B	Y N	157.000	0	0	C1-7.9-34. 36-47.49-8 4.86-121.1 23-159.161 -163	00/00/00 99/99/99
201114-105	CAP-CER.10000PF,50V,10%.X7R	3 J	27	2.000	1.000	EA	B	Y N	2.000	0	0	C164.165	00/00/00 99/99/99
202013-228	DIODE-ZENER	3 D	32	1.000	1.000	EA	B	N N	1.000	0	0	CP1	00/00/00 99/99/99
204010-533	TRANSISTOP-NPN.SILICON	3 F	40	2.000	1.000	EA	B	N N	2.000	0	0	Q1.2	00/00/00 99/99/99
200000-806	RES-8.06 KOHM .5% 1/8W FF	3 B	41	1.000	1.000	EA	F	N N	1.000	0	0	P43	00/00/00 99/99/99
200000-715	RES-7.15 KOHM 1/8W .5% FF	3 B	42	1.000	1.000	EA	F	N N	1.000	0	0	P42	00/00/00 99/99/99
200073-100	RES-1.0 KOHM 1/4W 5% CF	3 AC	43	13.000	1.000	EA	F	N N	15.000	0	0	R1.7-9.11- 14.20.22.3 7-39	00/00/00 99/99/99
200072-220	RES-220 OHM 1/4W 5% CF	3 AC	44	9.000	1.000	EA	F	N N	9.000	0	0	R2-6.21.29 .31.41	00/00/00 99/99/99
200073-470	RES-4.7 KOHM 1/4W 5% CF	3 AC	45	5.000	1.000	EA	F	N N	5.000	0	0	R16-18.26. 46	00/00/00 99/99/99
200073-220	RES-2.2 KOHM 1/4W 5% CF	3 AC	46	6.000	1.000	EA	F	N N	5.000	0	0	R19.23.25, 30.36.15	00/00/00 99/99/99
200071-100	RES-10 OHM 1/4W 5% CF	3 AC	48	1.000	1.000	EA	F	N N	1.000	0	0	R24	00/00/00 99/99/99
200073-330	RES-3.3 KOHM 1/4W 5% CF	3 AC	49	1.000	1.000	EA	F	N N	1.000	0	0	R44	00/00/00 99/99/99
200072-100	RES-100 OHM 1/4W 5% CF	3 AC	50	1.000	1.000	EA	F	N N	1.000	0	0	R33	00/00/00 99/99/99
200071-300	RES-30 OHM 1/4W 5% CF	3 AC	51	1.000	1.000	EA	B	N N	1.000	0	0	R34	00/00/00 99/99/99
200074-100	RES-10 KOHM 1/4W 5% CF	3 AC	52	2.000	1.000	EA	F	N N	2.000	0	0	R35.47	00/00/00 99/99/99
200075-270	RES-270 KOHM 1/4W 5% CF	3 AC	53	1.000	1.000	EA	F	N N	1.000	0	0	R45	00/00/00 99/99/99
200073-620	RES-6.2 KOHM 1/4W 5% CF	3 AC	54	1.000	1.000	EA	F	Y N	1.000	0	0	R10	00/00/00 99/99/99
970267-001	PIN-TEST..040SQ X .360LG	3 A	64	29.000	1.000	EA	F	Y N	29.000	0	0	TP1-12.16- 20.22-32,3 4 205026-999	00/00/00 99/99/99
970627-002	HEADER-UNSH,2 P DR,STR,.100	3 C	66	9.000	1.000	EA	B	Y N	4.000	0	0	W1-9	00/00/00 99/99/99
970227-001	JUMPER-2POS..100CTS.	3 C	67	2.000	1.000	EA	B	N N	2.000	0	0	W1.M3	00/00/00 99/99/99
203051-174	IC-74LS174,FF.D.HEX	3 L	68	1.000	1.000	EA	B	Y N	1.000	0	0	U14H	00/00/00 99/99/99

BILL OF MATERIAL
 =====
 AS OF 12/30/93

PAGE NO: 2

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963394-002 OPCODE: 4 REV: A PWB ASSY-CPU/MMU MGCR
 MODEL:
 ECO NO:
 DATE OF LAST ECO: 00/00/00

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	ITEM NO.	QTY ASSEMBLY	PER YIELD	FACTP	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970369-001	IC-4164 MEM MOS PAM 64KX1	3 G	71	58.000	1.000	EA B	N N			58.000	0	0 1E.2.4.5.7 .3.10.11.1 3.14.1F.2. 4.5.7.8.10 .11.13.14. 1G.2.4.5.7 .8.10.11.1 3.14.1H.2. 4.5.7.8.10 .11.13.14. 19N.21-24. 26.19N.21- 24.26.19P. 21-24.26	00/00/00	99/99/99
203052-244	IC-74LS244 BFR OCT 3S	3 L	72	8.000	1.000	EA B	N N			8.000	0	0 U3B.6D.9B. 9C.12D.16C .22B.27B	00/00/00	99/99/99
970385-001	IC-74LS14 INV SCHMITT HEX	3 J	73	1.000	1.000	EA B	N N			1.000	0	0 U3D	00/00/00	99/99/99
970324-001	IC-2966 DRVR OCTAL DYNANT	3 A	74	7.000	1.000	EA B	N N			7.000	0	0 U3J.12J.15 E.15F.18M. 27M.27P	00/00/00	99/99/99
970302-001	IC-2901 MICROPROCESSOR 4 BIT	3 A	75	5.000	1.000	EA B	N N			5.000	0	0 U3K.6K.9K. 12K.14K	00/00/00	99/99/99
970321-001	IC-74F374 FF D 3S OCT	3 D	76	3.000	1.000	EA B	N N			3.000	0	0 U6B.6J.9J	00/00/00	99/99/99
970354-001	IC-74S280 GEN/CKP PARITY 9BIT	3 B	77	2.000	1.000	EA B	N N			2.000	0	0 U6C.9D	00/00/00	99/99/99
970350-001	IC-74F08 AND 2IN QUAD	3 C	78	1.000	1.000	EA B	N N			1.000	0	0 U3C	00/00/00	99/99/99
205255-500	RES-RTWK 220/330 OHM 5% 1.5	3 E	79	1.000	1.000	EA B	N N			1.000	0	0 U12B	00/00/00	99/99/99
970274-001	IC-3911 CTRL TEMP	3 H	80	1.000	1.000	EA B	N N			1.000	0	0 U14N	00/00/00	99/99/99
970349-001	IC-74F32 OP 2IN QUAD	3 B	81	1.000	1.000	EA B	N N			1.000	0	0 U16B	00/00/00	99/99/99
970341-001	IC-74F86 EXOR	3 B	82	1.000	1.000	EA B	N N			1.000	0	0 U14C	00/00/00	99/99/99
970325-001	IC-74F74 FF D DUAL	3 D	83	5.000	1.000	EA B	N N			5.000	0	0 U12C.15K.1 6K.17E.23E	00/00/00	99/99/99
203029-003	IC-74LS11 AND 3IN TRIP	3 F	84	2.000	1.000	EA B	N N			1.000	0	0 U14D.6A	00/00/00	99/99/99
970357-001	IC-74LS256 4-BIT ADDRESSABLE	3 D	85	1.000	1.000	EA B	N N			1.000	0	0 U14J	00/00/00	99/99/99
970344-001	IC-74F109 FF JK DUAL	3 A	86	2.000	1.000	EA B	N N			2.000	0	0 U15D.16D	00/00/00	99/99/99
970318-001	IC-74F00 NAND 2IN QUAD	3 B	87	1.000	1.000	EA B	N N			1.000	0	0 U15H	00/00/00	99/99/99
203039-001	IC-74LS74 FF D DUAL	3 M	88	6.000	1.000	EA B	N N			6.000	0	0 U15L.16E.1 6L.17F.18D .22C	00/00/00	99/99/99
970011-001	IC-74LS04 INV HEX	3 D	89	2.000	1.000	EA B	N N			2.000	0	0 U23C.12A	00/00/00	99/99/99
970365-001	IC-8581 GEN CLK 6 MHZ	3 B	90	2.000	1.000	EA B	N N			2.000	0	0 U17C.27D	00/00/00	99/99/99

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.P. UNIQUE BOARD ASSY

963394-002 OPCODE: 4 REV: A PWB ASSY-CPU/MMU MGR
MODEL:
ECO NO:
DATE OF LAST ECO: 00/00/00

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	Q P	ITEM PU	QTY NO.	PER ASSEMBLY	YIELD FACTP	U1	SC	P E P	F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE SFO	DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970319-001	IC-74F191 CNTR REVEPSIBLE	3	B	93	1.000	1.000	EA	B	Y	N	1.000	0	0	U16F	00/00/00	99/99/99
970351-001	IC-74F138 DCDR/DEMUX 3-8 LINE	3	C	94	1.000	1.000	EA	B	N	N	1.000	0	0	U16H	00/00/00	99/99/99
970353-001	IC-74S112 FF EDGE	3	A	95	1.000	1.000	EA	B	N	N	1.000	0	0	U16J	00/00/00	99/99/99
970221-001	IC-74LS00 NAND 2IN POS QUAD	3	E	96	4.000	1.000	EA	B	N	N	4.000	0	0	U16N.18H.2 2D.25E	00/00/00	99/99/99
203075-032	IC-74LS32 OR 2IN QUAD	3	J	97	5.000	1.000	EA	B	N	N	4.000	0	0	U17D.20D.2 A3.25H.13A	00/00/00	99/99/99
203046-153	IC-74LS153 SEL/MULTP 4-1 LINE	3	G	98	3.000	1.000	EA	B	N	N	3.000	0	0	U17H.18E.1 8F	00/00/00	99/99/99
970342-001	IC-74F04 INI HEX	3	D	99	1.000	1.000	EA	B	Y	N	1.000	0	0	U17J	00/00/00	99/99/99
963147-001	S/W-GCR.ASSY.SELECT	3	A	100	2.000	1.000	EA	B	Y	N	2.000	0	0	U15A.18A	00/00/00	99/99/99
962957-001	S/W-GCR. ASSY. CRC GENERATOR	3	A	101	1.000	1.000	EA	B	Y	N	1.000	0	0	U16A	00/00/00	99/99/99
963142-001	S/W-GCR.ASSY.SMAP	3	A	102	1.000	1.000	EA	B	Y	N	1.000	0	0	U17A	00/00/00	99/99/99
203102-375	IC-74LS374 FF D OCT	3	F	104	2.000	1.000	EA	B	N	N	2.000	0	0	U17K.17L	00/00/00	99/99/99
203029-002	IC-74LS10 NAND 3IN TRIP	3	J	105	2.000	1.000	EA	B	N	N	1.000	0	0	U18B.14B	00/00/00	99/99/99
970358-001	IC-74S135 EXOR/NOR QUAD	3	C	106	1.000	1.000	EA	B	N	N	1.000	0	0	U19J	00/00/00	99/99/99
203094-500	IC-74LS109 FF JK POS EDGE	3	J	107	1.000	1.000	EA	B	N	N	1.000	0	0	U20C	00/00/00	99/99/99
203555-111	IC-8036 CIO 16BIT 6MHZ	3	C	108	2.000	1.000	EA	B	N	N	1.000	0	0	U20E.20A	00/00/00	99/99/99
203036-039	IC-74LS125 BUS BUF QUAD	3	F	109	1.000	1.000	EA	B	N	N	1.000	0	0	U20H	00/00/00	99/99/99
970010-001	IC-74LS08 AND 2IN QUAD	3	B	111	2.000	1.000	EA	B	N	N	2.000	0	0	U22E.27H	00/00/00	99/99/99
970320-001	IC-74F373 LATCH OCTAL	3	B	112	2.000	1.000	EA	B	N	N	2.000	0	0	U22F.27F	00/00/00	99/99/99
970352-001	IC-74LS28 NOR BUF	3	C	113	1.000	1.000	EA	B	N	N	1.000	0	0	U22H	00/00/00	99/99/99
962666-009	S/W-GCR. ASSY. CPU/MMU. U20K	0	A	114	1.000	1.000	EA	F	Y	N	1.000	0	0	U20K	00/00/00	99/99/99
962669-009	S/W-GCR. ASSY. CPU/MMU. U22K	0	A	115	1.000	1.000	EA	F	Y	N	1.000	0	0	U22K	00/00/00	99/99/99
962672-009	S/W-GCR.ASSY CPU/MMU,U23K	0	A	116	1.000	1.000	EA	F	Y	N	1.000	0	0	U23K	00/00/00	99/99/99
962675-009	S/W-GCR. ASSY. CPU/MMU. U25K	0	A	117	1.000	1.000	EA	F	Y	N	1.000	0	0	U25K	00/00/00	99/99/99
203061-280	IC-74LS280 PARITY TREE 9IN	3	C	118	2.000	1.000	EA	B	N	N	2.000	0	0	U22J.23J	00/00/00	99/99/99
203102-245	IC-74LS245 TRANSCEIVER BUS OCT	3	E	119	2.000	1.000	EA	B	N	N	2.000	0	0	U23B.25A	00/00/00	99/99/99
203046-150	IC-74LS42 DCDR BCD-DEC	3	C	121	2.000	1.000	EA	B	N	N	1.000	0	0	U23D.23A	00/00/00	99/99/99
970323-001	IC-2947 BIDIRECT OCT 3S	3	A	122	2.000	1.000	EA	B	N	N	2.000	0	0	U23F.25F	00/00/00	99/99/99
203115-001	IC-74LS01 NAND QUAD OPEN	3	A	123	1.000	1.000	EA	B	N	N	1.000	0	0	U23H	00/00/00	99/99/99
203575-111	IC-8002 CPU 16BIT 6 MHZ	3	C	124	1.000	1.000	EA	B	N	N	1.000	0	0	U25C	00/00/00	99/99/99
970348-001	IC-2210 MEM RAM STATIC-	3	C	129	1.000	1.000	EA	B	N	N	1.000	0	0	U25J	00/00/00	99/99/99
203046-156	IC-74LS139 1-4 DUAL	3	G	131	1.000	1.000	EA	B	N	N	1.000	0	0	U27E	00/00/00	99/99/99
203046-148	IC-74LS138 DCDR 3-8 LINE	3	K	132	1.000	1.000	EA	B	N	N	1.000	0	0	U27J	00/00/00	99/99/99
970555-018	SOCKET-IC 18 PIN..30	3	A	137	1.000	1.000	EA	B	Y	N	1.000	0	0	XU25.1	00/00/00	99/99/99
205025-528	SOCKET-DIP.28 CONTACT	3	E	139	4.000	1.000	EA	B	Y	N	4.000	0	0	XU20K.22K. 23K.25K	00/00/00	99/99/99
205025-540	SOCKET-DIP.40 CONTACT	3	E	140	1.000	1.000	EA	B	Y	N	1.000	0	0	XU25C	00/00/00	99/99/99
970370-001	CRYSTAL-HC18/U OT2.PRL	3	C	144	1.000	1.000	EA	B	N	N	1.000	0	0	Y1	00/00/00	99/99/99
210111-768	CRYSTAL-7.680MHZ.HC-18/U,	3	F	145	1.000	1.000	EA	B	N	N	1.000	0	0	Y2	00/00/00	99/99/99

ORIGINAL

LI.200.2.MDATAB01 CIPHER - SAN DIEGO - PRODUCTION DATA BASE
MON. OCT 17. 1988

BILL OF MATERIAL
=====

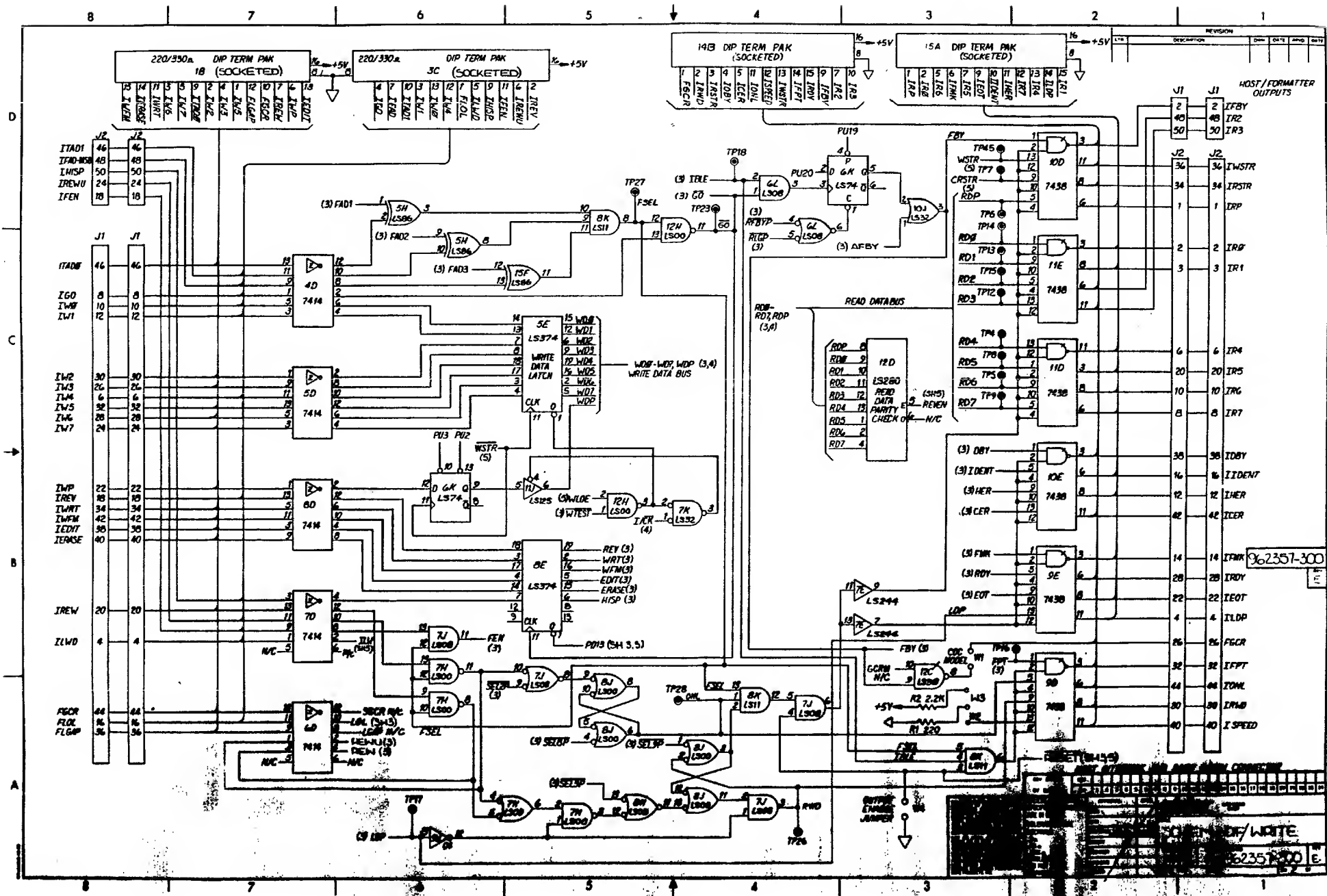
PAGE NO: 4

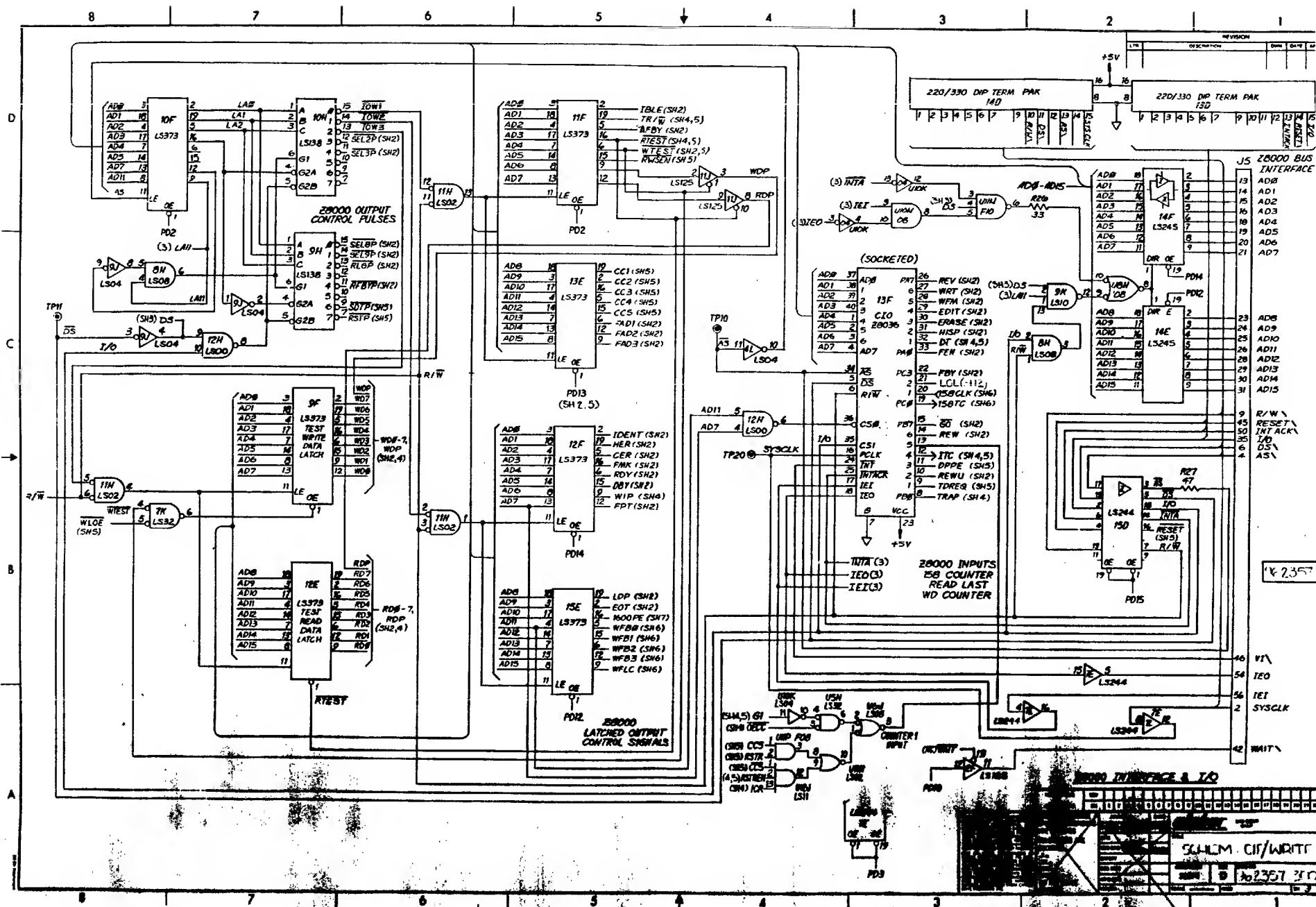
CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

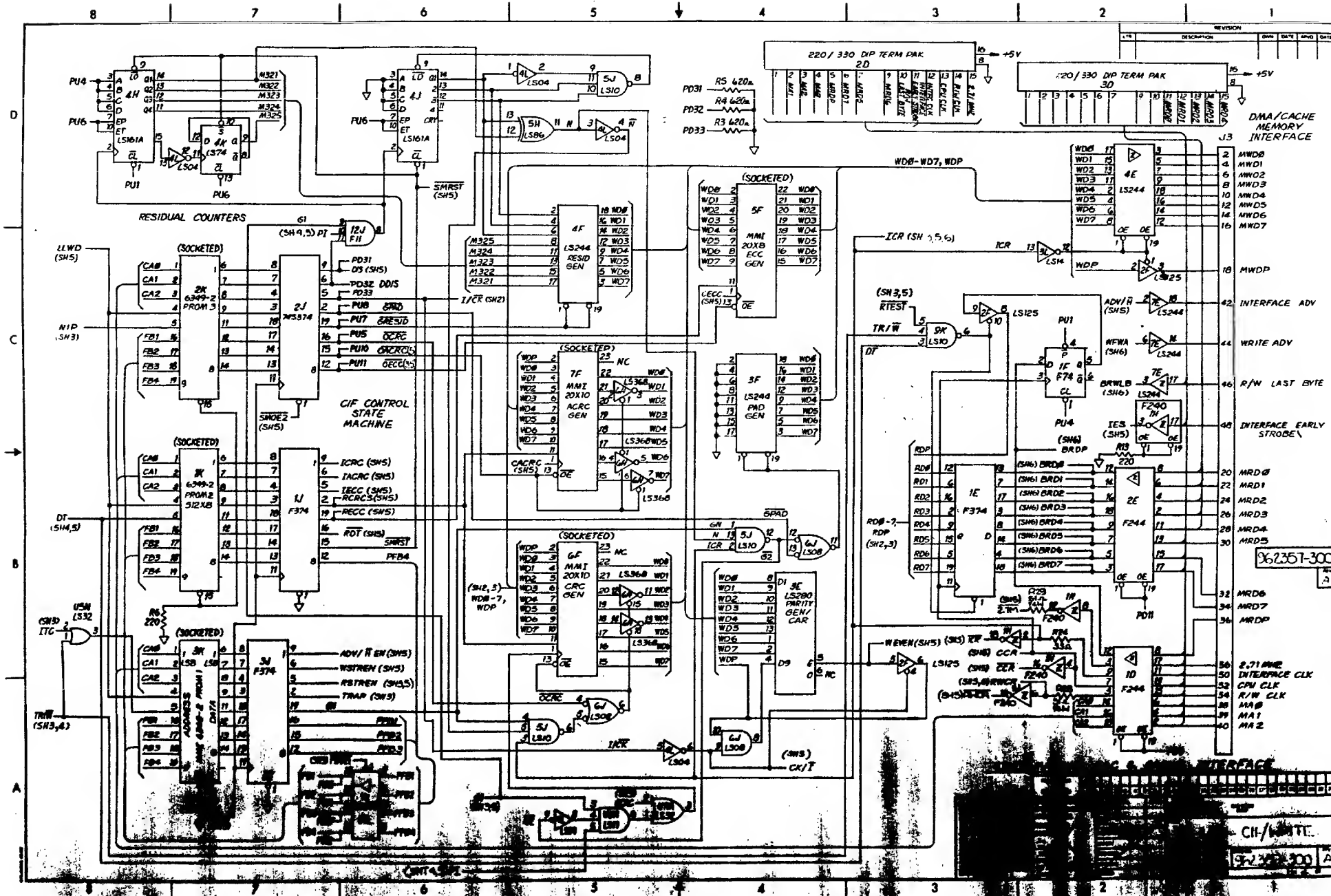
963394-002 OPCODE: 4 REV: A PWB ASSY-CPU/MMU MGCR
MODEL:
ECO NO:
DATE OF LAST ECO: 00/00/00

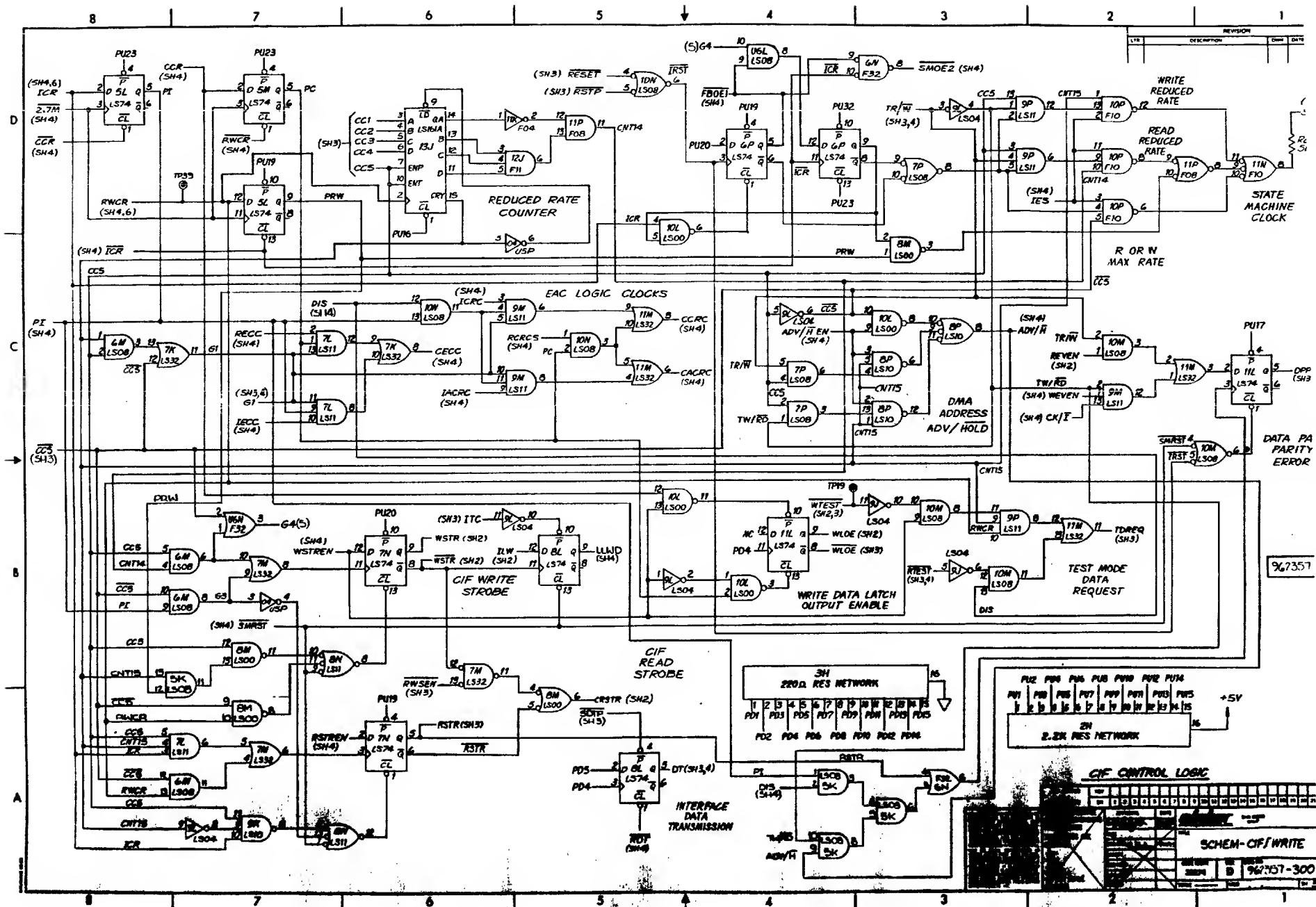
OP: ORDER POLICY CODE
RED:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

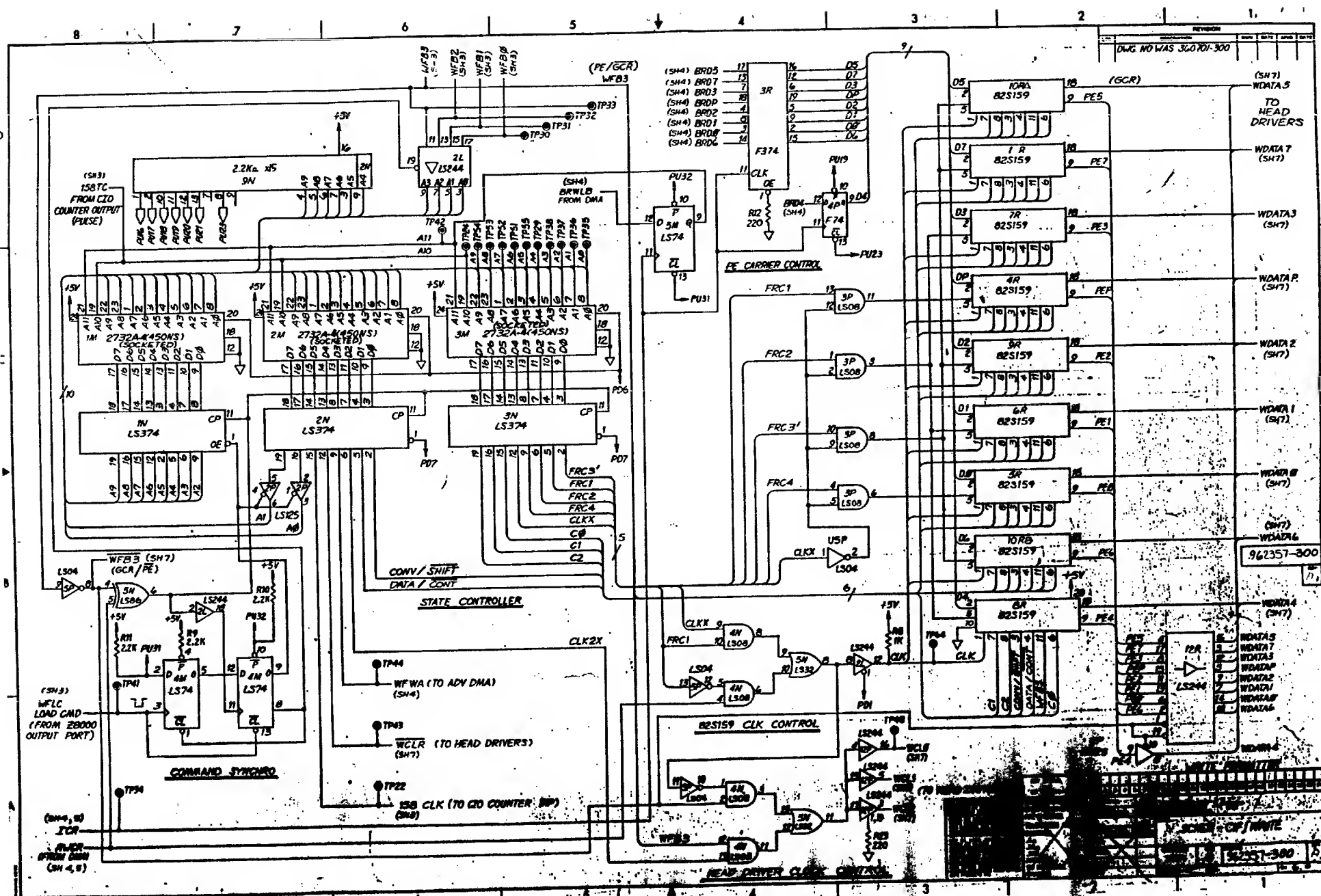
PART NUMBER	DESCRIPTION	O P PU	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTOR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
209990-108	ADHESIVE-CLEAR RTU	3 A	146	0.000	1.000	EA	F	Y N	0.000	0	0	00/00/00	99/99/99
209990-071	ADHESIVE-SUPERBONDER	3 C	147	0.000	1.000	EA	F	Y N	0.000	0	0	00/00/00	99/99/99
971041-001	LABEL-BAR CODE.1.425LX.25W.9.*	3 B	148	1.000	1.000	EA	F	Y N	1.000	0	0	00/00/00	99/99/99
208430-999	WIRE-30AWG.BLUE KYNAR.	3 A	149	.001	1.000	FT	F	Y N	.001	0	0	00/00/00	99/99/99



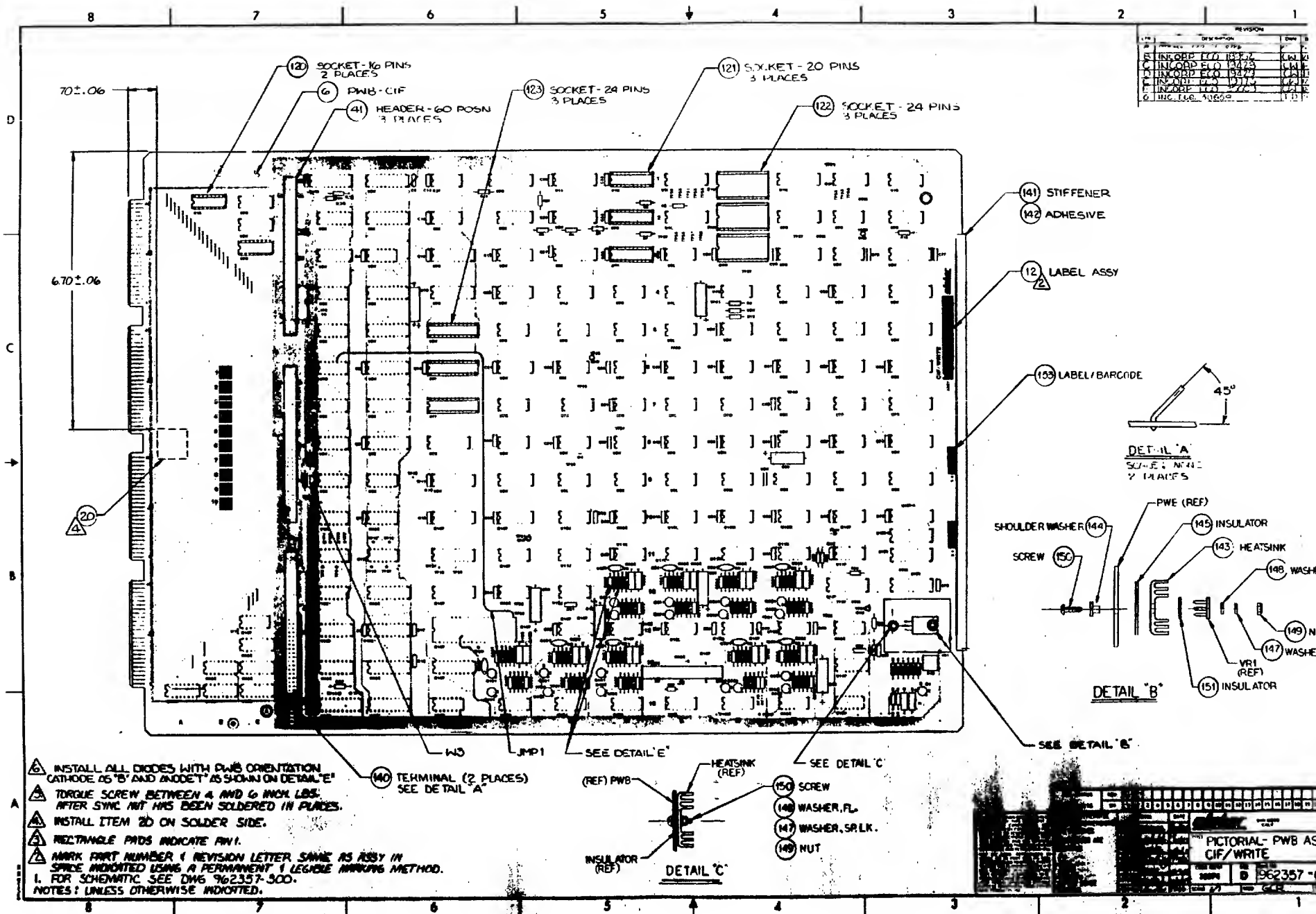








REV	DESCRIPTION	DATE	BY
1	STANDARD 100 100 100	10/1/72	WML
2	STANDARD 100 100 100	10/1/72	WML
3	STANDARD 100 100 100	10/1/72	WML
4	STANDARD 100 100 100	10/1/72	WML
5	STANDARD 100 100 100	10/1/72	WML
6	STANDARD 100 100 100	10/1/72	WML

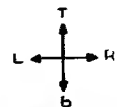


- ▲ INSTALL ALL DIODES WITH PWB ORIENTATION CATHODE AS "B" AND ANODE "A" AS SHOWN ON DETAIL "E"
 - ▲ TORQUE SCREW BETWEEN 4 AND 6 INCH LBS. AFTER SYNC NUT HAS BEEN SOLDERED IN PLACES.
 - ▲ INSTALL ITEM 20 ON SOLDER SIDE.
 - ▲ RECTANGLE PADS INDICATE PVI.
 - ▲ MARK PART NUMBER & REVISION LETTER SAME AS ASSY IN SPACE INDICATED USING A PERMANENT & LEGIBLE MARKING METHOD.
 - 1. FOR SCHEMATIC SEE DWG 762357-300.
- NOTES: UNLESS OTHERWISE INDICATED.

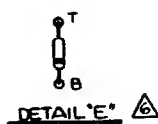


COMPONENT ADDED					
REF LEVEL	REF DES	FROM	TO	COMP SIDE	SLO SIDE
	CR102	Q102	J6-15	X	
	CR202	Q202	J6-17	X	
	CR302	Q302	J6-13	X	
	CR402	Q402	J6-19	X	
	CR502	Q502	J6-11	X	
	CR602	Q602	J6-1	X	
	CR702	Q702	J6-3	X	
	CR802	Q802	J6-9	X	
	CR902	Q902	J6-5	X	
	CR103	Q103	J6-14	X	
	CR203	Q203	J6-16	X	
	CR303	Q303	J6-12	X	
	CR403	Q403	J6-18	X	
	CR503	Q503	J6-10	X	
	CR603	Q603	J6-6	X	
	CR703	Q703	J6-2	X	
	CR803	Q803	J6-8	X	
	CR903	Q903	J6-4	X	

JUMPER LIST					
REF LEVEL	JMP NO	FROM	TO	COMP SIDE	SLO SIDE
662557-00 PLV D	1	U6C-10	U13F-21	X	



PWB ORIENTATION



662557-000

662557-000

LI,200.2.MDATAB01 CIPHER - SAN DIEGO - PRODUCTION DATA BASE
THU, MAY 26, 1988

DISTRIBUTION: DAWN - DOC.CONTROL

PAGE NO: 1

BILL OF MATERIAL

AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

962357-001 OPCODE: 3 REV: M PWB ASSY-CIF/WRITE
MODEL:
ECO NO: 30659
DATE OF LAST ECO: 5/26/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R U	ITEM NO.	QTY ASSEMBLY	PER YIELD	FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
962357-000	PICT-PWB ASSY,CIF/WRITE	3	G	1	0.000	1.000	EA	F	Y	N	0.000	0	0	ECO#18756	1/08/86	99/99/99
962357-300	SCHEM-CIF/WRITE	3	E	2	0.000	1.000	EA	F	Y	N	0.000	0	0	ECO#18756	1/08/86	99/99/99
460700-003	TEST SPEC CIF PWB	3		4	0.000	1.000	EA	F	N	N	0.000	0	0		00/00/00	99/99/99
962357-101	PWB-CIF/WRITE	3	A	6	1.000	1.000	EA	B	Y	N	1.000	0	0	ECO#18756	1/08/86	99/99/99
970267-001	PIN-TEST,.040SQ X .360LG	3	A	10	65.000	1.000	EA	F	Y	N	65.000	0	0	TP1-65 205026-999 ECO#18952	3/27/86	99/99/99
731006-800	LABEL-ASSY	3	B	12	1.000	1.000	EA	F	Y	N	1.000	0	0		8/28/85	99/99/99
970572-001	MOUNT-CABLE TIE,SMALL	3	A	20	1.000	1.000	EA	B	Y	N	1.000	0	0		8/28/85	99/99/99
970724-001	DIODE-1N4448,FAST SWITCHING	3	A	25	18.000	1.000	EA	B	Y	N	18.000	0	0	CR102-902, 103-903 EC 0#19428	11/17/86	99/99/99
204007-500	TRANSISTOR-NPN SILICON	3	J	28	18.000	1.000	EA	B	N	N	18.000	0	0	0101-901,1 02-902	00/00/00	99/99/99
970652-001	IC-337 VOLT REG	3	A	29	1.000	1.000	EA	B	Y	N	1.000	0	0	UR1	4/24/85	99/99/99
201191-063	CAP-ELEC,22MF,6.3V,-10+50%,AL	3	H	31	6.000	1.000	EA	B	Y	N	6.000	0	0	C1,2,10,30 .49,60 ECO #19608	4/27/87	99/99/99
970784-104	CAP-CER,.1UF,50V,-20+80%,AX,*	3	E	32	69.000	1.000	EA	B	Y	N	69.000	0	0	C3-9,11-29 31-40,42-4 8,50-53.55 -59,61-70, 72-75,77,7 8,81,82 ECO#19831 CRA#0036	7/25/86	99/99/99
201112-100	CAP-CER,100PF,50V,10%	3	G	33	1.000	1.000	EA	B	N	N	1.000	0	0	C80	00/00/00	99/99/99
201204-472	CAP-CER,47PF,50V,5%,NPO	3	R	34	1.000	1.000	EA	B	Y	N	1.000	0	0	C79	00/00/00	99/99/99
201244-104	CAP-CER,.1MF,50V,20%	3	E	35	2.000	1.000	EA	B	Y	N	2.000	0	0	C83,84	4/23/85	99/99/99
201191-025	CAP-ELEC,10MF,25V,ALUM	3	H	36	3.000	1.000	EA	B	Y	N	3.000	0	0	C41,54,71 ECO#19608	4/27/87	99/99/99
970303-060	CONN-HEADER,60 POSN,STR,	3	C	41	3.000	1.000	EA	B	Y	N	3.000	0	0	J3,4,5	8/28/85	99/99/99
970961-026	CONN-LOCK/EJECT,26POS,.100CTRS	3	B	42	1.000	1.000	EA	B	Y	N	1.000	0	0	U6 ECO#19500	7/24/87	99/99/99
200072-220	RES-220 OHM 1/4W 5% CF	3	AB	43	6.000	1.000	EA	F	N	N	6.000	0	0	R1,6,7,12, 13,23	00/00/00	99/99/99
200073-220	RES-2.2 KOHM 1/4W 5% CF	3	AB	44	4.000	1.000	EA	F	N	N	4.000	0	0	R2,9-11	00/00/00	99/99/99
200072-620	RES-620 OHM 1/4W 5% CF	3	AB	45	3.000	1.000	EA	F	N	N	3.000	0	0	R3-5	00/00/00	99/99/99
200073-100	RES-1.0 KOHM 1/4W 5% CF	3	AB	46	2.000	1.000	EA	F	Y	N	2.000	0	0	R8,17	00/00/00	99/99/99
200072-150	RES-150 OHM 1/4W 5% CF	3	AB	47	2.000	1.000	EA	F	N	N	2.000	0	0	R14,15	00/00/00	99/99/99
200073-470	RES-4.7 KOHM 1/4W 5% CF	3	AB	48	1.000	1.000	EA	F	N	N	1.000	0	0	R16	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 2

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

962357-001 OPCODE: 3 REV: M PMB ASSY-CIF/WRITE
MODEL:
FCO NO: 30659
DATE OF LAST ECO: 5/26/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	ITEM RV	QTY NO.	PER ASSEMBLY	YFLD FACTR	UM	SC	R E	P F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200215-103	RES-POT,10K	3	D	49	1.000	1.000	EA	B	N	N	1.000	0	0	R18	00/00/00	99/99/99
200012-750	RES-750 OHM 1/4W 1% FF	3	R	52	1.000	1.000	EA	B	Y	N	1.000	0	0	R30	4/23/85	99/99/99
200071-510	RES-51 OHM 1/4W 5% CF	3	AB	53	21.000	1.000	FA	F	Y	N	21.000	0	0	R25,28,29, 102-902,10 4-904	00/00/00	99/99/99
200013-221	RES-2.21 KOHM 1/4W 1% FF	3	R	54	1.000	1.000	EA	F	Y	N	1.000	0	0	R31	4/23/85	99/99/99
970657-001	RES-274 OHM 1W 1% MF	3	B	55	9.000	1.000	EA	F	Y	N	9.000	0	0	R106-R906 970656-001	5/02/85	99/99/99
200072-390	RES-390 OHM 1/4W 5% CF	3	AB	56	18.000	1.000	EA	F	N	N	18.000	0	0	R107-907,1 08-908	00/00/00	99/99/99
200072-470	RES-470 OHM 1/4W 5% CF	3	AB	58	9.000	1.000	EA	F	Y	N	9.000	0	0	R111-911	00/00/00	99/99/99
205255-500	RES-NTWK 220/330 OHM 5% 1.5	3	E	59	6.000	1.000	EA	B	N	N	6.000	0	0	1B,2D,3C,3 D,13D,14D	00/00/00	99/99/99
970345-001	RES-NTWK 2.2 KOHM DIP 16P	3	D	61	2.000	1.000	EA	B	N	N	2.000	0	0	2H,9N	00/00/00	99/99/99
970345-002	RES-NTWK 220 OHM DIP 16P	3	D	62	1.000	1.000	EA	B	N	N	1.000	0	0	3H	00/00/00	99/99/99
200071-470	RES-47 OHM 1/4W 5% CF	3	AB	63	1.000	1.000	EA	F	N	N	1.000	0	0	R27	00/00/00	99/99/99
200071-330	RES-33 OHM 1/4W 5% CF	3	AB	64	2.000	1.000	FA	F	N	N	2.000	0	0	R24,26	00/00/00	99/99/99
208500-300	WIRE,BUS TND COPPER 26AWG	3	B	66	0.000	1.000	EA	F	Y	N	0.000	0	0	W3	3/27/86	99/99/99
970406-001	IC-74S374 FF D OCT	3	B	70	1.000	1.000	EA	B	N	N	1.000	0	0	ECO#18952 U2J	00/00/00	99/99/99
203052-244	IC-74LS244 BFR OCT 3S	3	L	71	9.000	1.000	EA	B	N	N	9.000	0	0	U1L,2L,3F, 4E,4F,7E,1 2P,12R,15D	00/00/00	99/99/99
203102-375	IC-74LS374 FF D OCT	3	F	72	5.000	1.000	EA	B	N	N	5.000	0	0	1N,2N,3N,5 E,8E	00/00/00	99/99/99
203039-001	IC-74LS74 FF D DUAL	3	M	73	9.000	1.000	EA	B	N	N	9.000	0	0	U4K,4M,5L, 5M,6K,6P,7 N,8L,11L	00/00/00	99/99/99
970347-001	IC-74F240 INU BUF 3S OCT	3	C	74	1.000	1.000	EA	B	N	N	1.000	0	0	U1H	00/00/00	99/99/99
970346-001	IC-74F244 DRUR OCTAL BUF	3	C	77	2.000	1.000	EA	B	N	N	2.000	0	0	U1D,2E	00/00/00	99/99/99
203036-039	IC-74LS125 BUS BUF QUAD	3	F	78	3.000	1.000	EA	B	N	N	3.000	0	0	U2F,2P,11J	00/00/00	99/99/99
203061-280	IC-74LS280 PARITY TREE 9IN	3	C	79	2.000	1.000	EA	B	N	N	2.000	0	0	U3E,12D	00/00/00	99/99/99
203085-001	IC-74LS14 INU SCHMITT HEX	3	J	80	1.000	1.000	EA	B	N	N	1.000	0	0	U3L	00/00/00	99/99/99
970010-001	IC-74LS08 AND 2IN QUAD	3	B	81	11.000	1.000	EA	B	N	N	11.000	0	0	U3P,4N,5K, 6L,6J,6M,7 J,7P,8H,10 M,10N	00/00/00	99/99/99
970321-001	IC-74F374 FF D 3S OCT	3	D	82	4.000	1.000	EA	B	N	N	4.000	0	0	U1E,1J,3J, 3R	00/00/00	99/99/99
203029-500	IC-7414 INU HEX SCHMITT TRIP,	3	C	83	5.000	1.000	EA	B	N	N	5.000	0	0	U4D,5D,6D, 7D,8D	00/00/00	99/99/99

ORIGINAL

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

962357-001 OPCODE: 3 REV: M PWB ASSY-CIF/WRITE
 MODEL:
 ECO NO: 30659
 DATE OF LAST ECO: 5/26/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	Q P	ITEM RU	QTY NO.	PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	OFF SET	DAYS SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
203048-100	IC-74LS161 CNTR 4BIT SYNC	3	L	84	3.000	1.000	EA	B	N N	3.000	0	0	U4H,4J,13J	00/00/00	99/99/99
970011-001	IC-74LS04 INV HEX	3	D	85	5.000	1.000	EA	B	N N	5.000	0	0	U4L,5P,9J, 9L,10K	00/00/00	99/99/99
203035-032	IC-74LS32 OR 2IN QUAD	3	J	86	5.000	1.000	EA	B	N N	5.000	0	0	U5N,7K,7M, 10J,11M	00/00/00	99/99/99
970325-001	IC-74F74 FF D DUAL	3	D	87	2.000	1.000	EA	B	N N	2.000	0	0	U1F,4P	00/00/00	99/99/99
203102-373	IC-74LS373 LATCH D OCT	3	G	89	7.000	1.000	EA	B	N N	8.000	0	0	U9F,10F,11 F,12E,12F, 13E,15E	00/00/00	99/99/99
203042-001	IC-74LS86 XOR QUAD	3	K	91	4.000	1.000	EA	B	N N	4.000	0	0	U5H,13P,15 F,15L	00/00/00	99/99/99
203029-002	IC-74LS10 NAND 3IN TRIP	3	J	92	3.000	1.000	EA	B	N N	3.000	0	0	U5J,8P,9K	00/00/00	99/99/99
203122-368	IC-74LS368 HEX BUS DRIVER	3	L	94	1.000	1.000	EA	B	N N	1.000	0	0	6H	00/00/00	99/99/99
970349-001	IC-74F32 OR 2IN QUAD	3	B	95	1.000	1.000	EA	B	N N	1.000	0	0	U6N	00/00/00	99/99/99
970221-001	IC-74LS00 NAND 2IN POS QUAD	3	E	96	5.000	1.000	EA	B	N N	5.000	0	0	U7H,8J,8M, 10L,12H	00/00/00	99/99/99
203029-003	IC-74LS11 AND 3IN TRIP	3	F	97	5.000	1.000	EA	B	N N	5.000	0	0	U7L,8K,9N, 9M,9P	00/00/00	99/99/99
203036	IC-7438 NAND 2IN BUF QUAD	3	E	99	6.000	1.000	EA	B	N N	6.000	0	0	U9D,9E,10D ,10E,11D,1 1E	00/00/00	99/99/99
203046-148	IC-74LS138 DCDR 3-8 LINE	3	K	100	2.000	1.000	EA	B	N N	2.000	0	0	U9H,10H	00/00/00	99/99/99
970356-001	IC-74F10 NAND	3	C	101	2.000	1.000	EA	B	N N	2.000	0	0	U10P,11N	00/00/00	99/99/99
203081-001	IC-74LS02 NOR 2IN POS QUAD	3	J	102	1.000	1.000	EA	B	N N	1.000	0	0	U11H	00/00/00	99/99/99
970342-001	IC-74F04 INV HEX	3	D	103	1.000	1.000	EA	B	N N	1.000	0	0	U11K	00/00/00	99/99/99
970350-001	IC-74F08 AND 2IN QUAD	3	C	104	1.000	1.000	EA	B	N N	1.000	0	0	U11P	00/00/00	99/99/99
203036-038	IC-74LS38 NAND 2IN POS BUF	3	H	105	1.000	1.000	EA	B	N N	1.000	0	0	U12C	00/00/00	99/99/99
970355-001	IC-74F11 AND TRIP	3	C	106	1.000	1.000	EA	B	N N	1.000	0	0	U12J	00/00/00	99/99/99
203555-111	IC-8036 CIO 16BIT 6MHZ	3	C	107	1.000	1.000	EA	B	N N	1.000	0	0	U13F	00/00/00	99/99/99
203039	IC-7474 FF D POS EDGE DUAL	3	C	108	9.000	1.000	EA	B	N N	9.000	0	0	U13K,13L,1 3M,13N,15H ,15J,15K,1 5M,15N	00/00/00	99/99/99
203102-245	IC-74LS245 TRANSCEIVR. BUS OCT	3	E	109	2.000	1.000	EA	B	N N	2.000	0	0	U14E,14F	00/00/00	99/99/99
203046-001	IC-74LS123 MLTV DUAL	3	G	110	1.000	1.000	EA	B	N N	1.000	0	0	U14P	00/00/00	99/99/99
211011-016	SOCKET-16 PIN LOW PROFILE	3	D	120	2.000	1.000	EA	B	Y N	2.000	0	0	XU1B,3C	8/28/85	99/99/99
970555-020	SOCKET-IC 20 PIN, .30	3	A	121	3.000	1.000	EA	B	Y N	3.000	0	0	XU1K,2K,3K	8/28/85	99/99/99
205025-524	SOCKET-DIP,24 CONTACTS	3	E	122	3.000	1.000	EA	B	Y N	3.000	0	0	XU1M,2M,3M	8/28/85	99/99/99
970555-024	SOCKET-IC 24 PIN, .30	3	A	123	3.000	1.000	EA	B	N N	3.000	0	0	XU5F,6F,7F	00/00/00	99/99/99
961243-001	S/W-GCR,ASSY,WRITE FMTR	1	A	126	1.000	1.000	EA	B	N N	1.000	0	0	U1M	00/00/00	99/99/99
961244-001	S/W-GCR,ASSY,WRITE FMTR	1	A	127	1.000	1.000	EA	B	N N	1.000	0	0	U2M	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

962357-001 OPCODE: 3 REV: M PWB ASSY-CIF/WRITE
MODEL:
ECO NO: 30659
DATE OF LAST ECO: 5/26/88

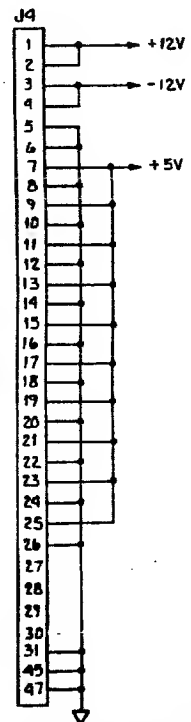
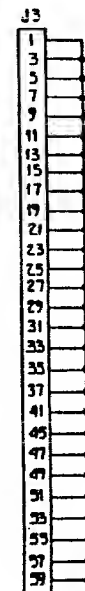
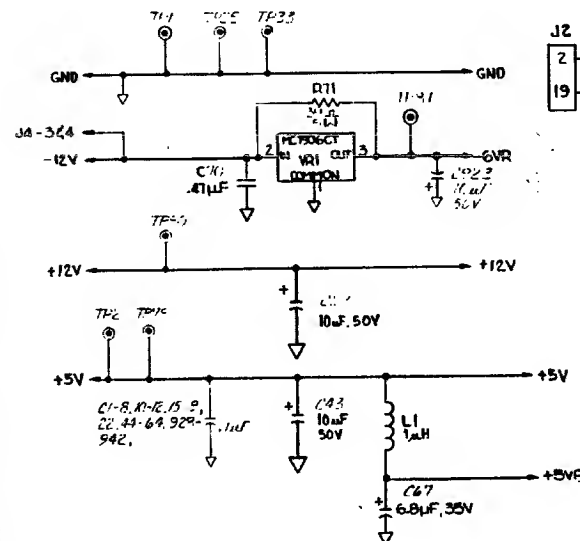
OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	RU	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q	F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
961245-001	S/W-GCR,ASSY,WRITE FMTR	1	A	128	1.000	1.000	EA	B	N	N	1.000	0	0	U3M	00/00/00	99/99/99
961246-001	S/W-GCR,ASSY,WRITE CHAN	1	A	129	3.000	1.000	EA	B	N	N	3.000	0	0	U4R,5R,10R A	00/00/00	99/99/99
961247-001	S/W-GCR,ASSY,WRITE CHAN	1	A	130	1.000	1.000	EA	B	N	N	1.000	0	0	U6R	00/00/00	99/99/99
961248-001	S/W-GCR,ASSY,WRITE CHAN	1	A	131	2.000	1.000	EA	B	N	N	2.000	0	0	U7R,8R	00/00/00	99/99/99
961249-001	S/W-GCR,ASSY,WRITE CHAN	1	A	132	3.000	1.000	EA	B	N	N	3.000	0	0	U9R,10RB,1 iR	00/00/00	99/99/99
961373-002	S/W-GCR,ASSY,INTERFACE	1	B	133	1.000	1.000	EA	B	N	N	1.000	0	0	U1K	00/00/00	99/99/99
961375-001	S/W-GCR,ASSY,INTERFACE	1	B	134	1.000	1.000	EA	B	N	N	1.000	0	0	U2K	00/00/00	99/99/99
961376-002	S/W-GCR,ASSY,INTERFACE	1	A	135	1.000	1.000	EA	B	N	N	1.000	0	0	U3K	00/00/00	99/99/99
961377-001	S/W-GCR,ASSY,ECC	1	B	136	1.000	1.000	EA	B	N	N	1.000	0	0	U5F	00/00/00	99/99/99
961371-001	S/W-GCR,ASSY,CRC	1	B	137	1.000	1.000	EA	B	N	N	1.000	0	0	U6F	00/00/00	99/99/99
961374-001	S/W-GCR,ASSY,ACRC	1	B	138	1.000	1.000	EA	B	N	N	1.000	0	0	U7F	00/00/00	99/99/99
970058-002	TERMINAL-MALE .250 TAB	3	C	140	2.000	1.000	EA	B	N	N	4.000	0	0		00/00/00	99/99/99
961707-002	STIFFENER-EDGE,PCB	3	B	141	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
209990-071	ADHESIVE-SUPERBONDER	3	C	142	0.000	1.000	EA	F	N	N	.001	0	0		00/00/00	99/99/99
970281-003	HEATSINK-TO-127/TO-220,15.33*	3	C	143	1.000	1.000	EA	B	Y	N	1.000	0	0	(UR1) ECO#19167	8/04/86	99/99/99
216155-049	WASHER-SHOULDER,#4,	3	A	144	1.000	1.000	EA	F	Y	N	1.000	0	0		4/23/85	99/99/99
964421-001	INSULATOR-THERMALLY,CONDUCTIVE	3	A	145	1.000	1.000	EA	F	Y	N	1.000	0	0	ECO#19791	8/10/87	99/99/99
207403-011	WASHER-SPLIT LOCK #4	3	D	147	2.000	1.000	EA	F	Y	N	2.000	0	0		11/22/85	99/99/99
207403-021	WASHER-FLAT	3	C	148	2.000	1.000	EA	F	Y	N	2.000	0	0		11/22/85	99/99/99
207406-081	NUT-HEX RADIO PAT. #4	3	B	149	2.000	1.000	EA	F	Y	N	2.000	0	0		11/22/85	99/99/99
213271-407	SCREW-PHP,ZINC,4-40X 7/16	3	G	150	2.000	1.000	EA	F	Y	N	2.000	0	0	ECO#19773	4/24/87	99/99/99
210875-501	INSULATOR-THERMALLY	3	B	151	1.000	1.000	EA	B	Y	N	1.000	0	0	(UR1)	12/04/85	99/99/99
208430-900	WIRE-30AWG,KYNAR ROLL,UL	3	E	152	1.000	1.000	FT	F	Y	N	1.000	0	0	ECO#30009	8/26/87	99/99/99
971041-001	LABEL-BAR CODE,1.425LX.25W,9.*	3	B	153	1.000	1.000	EA	F	Y	N	1.000	0	0	ECO#30659	5/27/88	99/99/99

TYPE	REF DESG	+12V	+5V	-6V	GND
PAL 20 X 10	U1J, U13J		24		12
74LS688	U1M, U13M		20		10
PAL 20 X 8	U16J		24		12
SPAPE	U20M, U20S, U16A, U16E		16		8
SPAPE	U19U		14		7
C-5061	U26B, U26D, U26F, U26H, U26K, U26M, U26P, U26S, U26U, U26V, U26W	4	10	1	5
74LS373	U26E, U26I		20		10
'LS74	U21A, U22B, U23B, U22D, U23D, U22S, U20G, U22F, U23F, U22H, U23H, U21J, U22K, U23K, U22M, U23M, U21P, U22P, U23P, U21U, U23U, U10E, U23S, U22U, U11M, U11P		14		7
'S223	U20A, U21A, U20C, U21C, U20E, U21E, U20F, U21F, U20H, U21H, U21M, U20L, U20N, U21L, U20R, U21R, U20T, U21T		20		10
74LS138	U5T				
'LS273	U19A, U19C, U10C, U19E, U19F, U19P, U19L, U19R, U64, U6H, U6N, U6T		20		10
'LS174	U15B, U15C, U21Q, U14, U5H, U10H, U12H, U25G, U21M, U21S, U25J, U14H		16		8
2732A	U15A, U15C, U15E, U15F, U15J, U15L, U15N, U15R, U15T, U5S, U10G		24		12
MC4044	U25A, U25C, U25E, U25G, U25J, U25L, U25N, U25R, U25T		14		7
CD4066	U25A, U25C, U25E, U25G, U25J, U25L, U25N, U25R, U25T		14		7
'LS133	U19D, U19G, U19S, U19M, U18U		16		8
'LS00	U20B, U20D, U20J, U20P, U20U, U6B		14		7
'LS08	U5C, U3G, U6C, U10B, U15B, U15L, U15P		14		7
'LS244	U10A, U12A, U3A, U3B		20		10
'LS14	U1E, U13P		14		7
'LS245	U15A		20		10
'LS02	U15E, U11L		14		7
'LS04	U6E, U12E, U12K		14		7
'LS06	U1G		14		7
'LS148	U12G		16		8
'LS107	U3F, U10F		16		8
'LS123	U1F, U13R		14		7
'LS21	U1A		14		7
'LS32	U1C, U5E		14		7
24541	U12J, U15H, U15G		18		9
8036	U12B		23		7
333	U12F		3		12
F74	U1B, U6F		14		7
LS05-1	U5F		16		8
74221	U24B, U24D, U25Q, U25R, U25S, U25A, U25C, U25E, U25G, U25J, U25L, U25N, U25R, U25T, U25U, U25V, U25W, U25X, U25Y, U25Z, U25AA, U25AB, U25AC, U25AD, U25AE, U25AF, U25AG, U25AH, U25AI, U25AJ, U25AK, U25AL, U25AM, U25AN, U25AO, U25AP, U25AQ, U25AR, U25AS, U25AT, U25AU, U25AV, U25AW, U25AX, U25AY, U25AZ, U25BA, U25BB, U25BC, U25BD, U25BE, U25BF, U25BG, U25BH, U25BI, U25BJ, U25BK, U25BL, U25BM, U25BN, U25BO, U25BP, U25BQ, U25BR, U25BS, U25BT, U25BU, U25BV, U25BW, U25BX, U25BY, U25BZ, U25CA, U25CB, U25CC, U25CD, U25CE, U25CF, U25CG, U25CH, U25CI, U25CJ, U25CK, U25CL, U25CM, U25CN, U25CO, U25CP, U25CQ, U25CR, U25CS, U25CT, U25CU, U25CV, U25CW, U25CX, U25CY, U25CZ, U25DA, U25DB, U25DC, U25DD, U25DE, U25DF, U25DG, U25DH, U25DI, U25DJ, U25DK, U25DL, U25DM, U25DN, U25DO, U25DP, U25DQ, U25DR, U25DS, U25DT, U25DU, U25DV, U25DW, U25DX, U25DY, U25DZ, U25EA, U25EB, U25EC, U25ED, U25EE, U25EF, U25EG, U25EH, U25EI, U25EJ, U25EK, U25EL, U25EM, U25EN, U25EO, U25EP, U25EQ, U25ER, U25ES, U25ET, U25EU, U25EV, U25EW, U25EX, U25EY, U25EZ, U25FA, U25FB, U25FC, U25FD, U25FE, U25FF, U25FG, U25FH, U25FI, U25FJ, U25FK, U25FL, U25FM, U25FN, U25FO, U25FP, U25FQ, U25FR, U25FS, U25FT, U25FU, U25FV, U25FW, U25FX, U25FY, U25FZ, U25GA, U25GB, U25GC, U25GD, U25GE, U25GF, U25GG, U25GH, U25GI, U25GJ, U25GK, U25GL, U25GM, U25GN, U25GO, U25GP, U25GQ, U25GR, U25GS, U25GT, U25GU, U25GV, U25GW, U25GX, U25GY, U25GZ, U25HA, U25HB, U25HC, U25HD, U25HE, U25HF, U25HG, U25HH, U25HI, U25HJ, U25HK, U25HL, U25HM, U25HN, U25HO, U25HP, U25HQ, U25HR, U25HS, U25HT, U25HU, U25HV, U25HW, U25HX, U25HY, U25HZ, U25IA, U25IB, U25IC, U25ID, U25IE, U25IF, U25IG, U25IH, U25II, U25IJ, U25IK, U25IL, U25IM, U25IN, U25IO, U25IP, U25IQ, U25IR, U25IS, U25IT, U25IU, U25IV, U25IW, U25IX, U25IY, U25IZ, U25JA, U25JB, U25JC, U25JD, U25JE, U25JF, U25JG, U25JH, U25JI, U25JJ, U25JK, U25JL, U25JM, U25JN, U25JO, U25JP, U25JQ, U25JR, U25JS, U25JT, U25JU, U25JV, U25JW, U25JX, U25JY, U25JZ, U25KA, U25KB, U25KC, U25KD, U25KE, U25KF, U25KG, U25KH, U25KI, U25KJ, U25KK, U25KL, U25KM, U25KN, U25KO, U25KP, U25KQ, U25KR, U25KS, U25KT, U25KU, U25KV, U25KW, U25KX, U25KY, U25KZ, U25LA, U25LB, U25LC, U25LD, U25LE, U25LF, U25LG, U25LH, U25LI, U25LJ, U25LK, U25LL, U25LM, U25LN, U25LO, U25LP, U25LQ, U25LR, U25LS, U25LT, U25LU, U25LV, U25LW, U25LX, U25LY, U25LZ, U25MA, U25MB, U25MC, U25MD, U25ME, U25MF, U25MG, U25MH, U25MI, U25MJ, U25MK, U25ML, U25MM, U25MN, U25MO, U25MP, U25MQ, U25MR, U25MS, U25MT, U25MU, U25MV, U25MW, U25MX, U25MY, U25MZ, U25NA, U25NB, U25NC, U25ND, U25NE, U25NF, U25NG, U25NH, U25NI, U25NJ, U25NK, U25NL, U25NM, U25NN, U25NO, U25NP, U25NQ, U25NR, U25NS, U25NT, U25NU, U25NV, U25NW, U25NX, U25NY, U25NZ, U25OA, U25OB, U25OC, U25OD, U25OE, U25OF, U25OG, U25OH, U25OI, U25OJ, U25OK, U25OL, U25OM, U25ON, U25OO, U25OP, U25OQ, U25OR, U25OS, U25OT, U25OU, U25OV, U25OW, U25OX, U25OY, U25OZ, U25PA, U25PB, U25PC, U25PD, U25PE, U25PF, U25PG, U25PH, U25PI, U25PJ, U25PK, U25PL, U25PM, U25PN, U25PO, U25PP, U25PQ, U25PR, U25PS, U25PT, U25PU, U25PV, U25PW, U25PX, U25PY, U25PZ, U25QA, U25QB, U25QC, U25QD, U25QE, U25QF, U25QG, U25QH, U25QI, U25QJ, U25QK, U25QL, U25QM, U25QN, U25QO, U25QP, U25QQ, U25QR, U25QS, U25QT, U25QU, U25QV, U25QW, U25QX, U25QY, U25QZ, U25RA, U25RB, U25RC, U25RD, U25RE, U25RF, U25RG, U25RH, U25RI, U25RJ, U25RK, U25RL, U25RM, U25RN, U25RO, U25RP, U25RQ, U25RR, U25RS, U25RT, U25RU, U25RV, U25RW, U25RX, U25RY, U25RZ, U25SA, U25SB, U25SC, U25SD, U25SE, U25SF, U25SG, U25SH, U25SI, U25SJ, U25SK, U25SL, U25SM, U25SN, U25SO, U25SP, U25SQ, U25SR, U25SS, U25ST, U25SU, U25SV, U25SW, U25SX, U25SY, U25SZ, U25TA, U25TB, U25TC, U25TD, U25TE, U25TF, U25TG, U25TH, U25TI, U25TJ, U25TK, U25TL, U25TM, U25TN, U25TO, U25TP, U25TQ, U25TR, U25TS, U25TT, U25TU, U25TV, U25TW, U25TX, U25TY, U25TZ, U25UA, U25UB, U25UC, U25UD, U25UE, U25UF, U25UG, U25UH, U25UI, U25UJ, U25UK, U25UL, U25UM, U25UN, U25UO, U25UP, U25UQ, U25UR, U25US, U25UT, U25UU, U25UV, U25UW, U25UX, U25UY, U25UZ, U25VA, U25VB, U25VC, U25VD, U25VE, U25VF, U25VG, U25VH, U25VI, U25VJ, U25VK, U25VL, U25VM, U25VN, U25VO, U25VP, U25VQ, U25VR, U25VS, U25VT, U25VU, U25VV, U25VW, U25VX, U25VY, U25VZ, U25WA, U25WB, U25WC, U25WD, U25WE, U25WF, U25WG, U25WH, U25WI, U25WJ, U25WK, U25WL, U25WM, U25WN, U25WO, U25WP, U25WQ, U25WR, U25WS, U25WT, U25WU, U25WV, U25WW, U25WX, U25WY, U25WZ, U25XA, U25XB, U25XC, U25XD, U25XE, U25XF, U25XG, U25XH, U25XI, U25XJ, U25XK, U25XL, U25XM, U25XN, U25XO, U25XP, U25XQ, U25XR, U25XS, U25XT, U25XU, U25XV, U25XW, U25XX, U25XY, U25XZ, U25YA, U25YB, U25YC, U25YD, U25YE, U25YF, U25YG, U25YH, U25YI, U25YJ, U25YK, U25YL, U25YM, U25YN, U25YO, U25YP, U25YQ, U25YR, U25YS, U25YT, U25YU, U25YV, U25YW, U25YX, U25YY, U25YZ, U25ZA, U25ZB, U25ZC, U25ZD, U25ZE, U25ZF, U25ZG, U25ZH, U25ZI, U25ZJ, U25ZK, U25ZL, U25ZM, U25ZN, U25ZO, U25ZP, U25ZQ, U25ZR, U25ZS, U25ZT, U25ZU, U25ZV, U25ZW, U25ZX, U25ZY, U25ZZ				

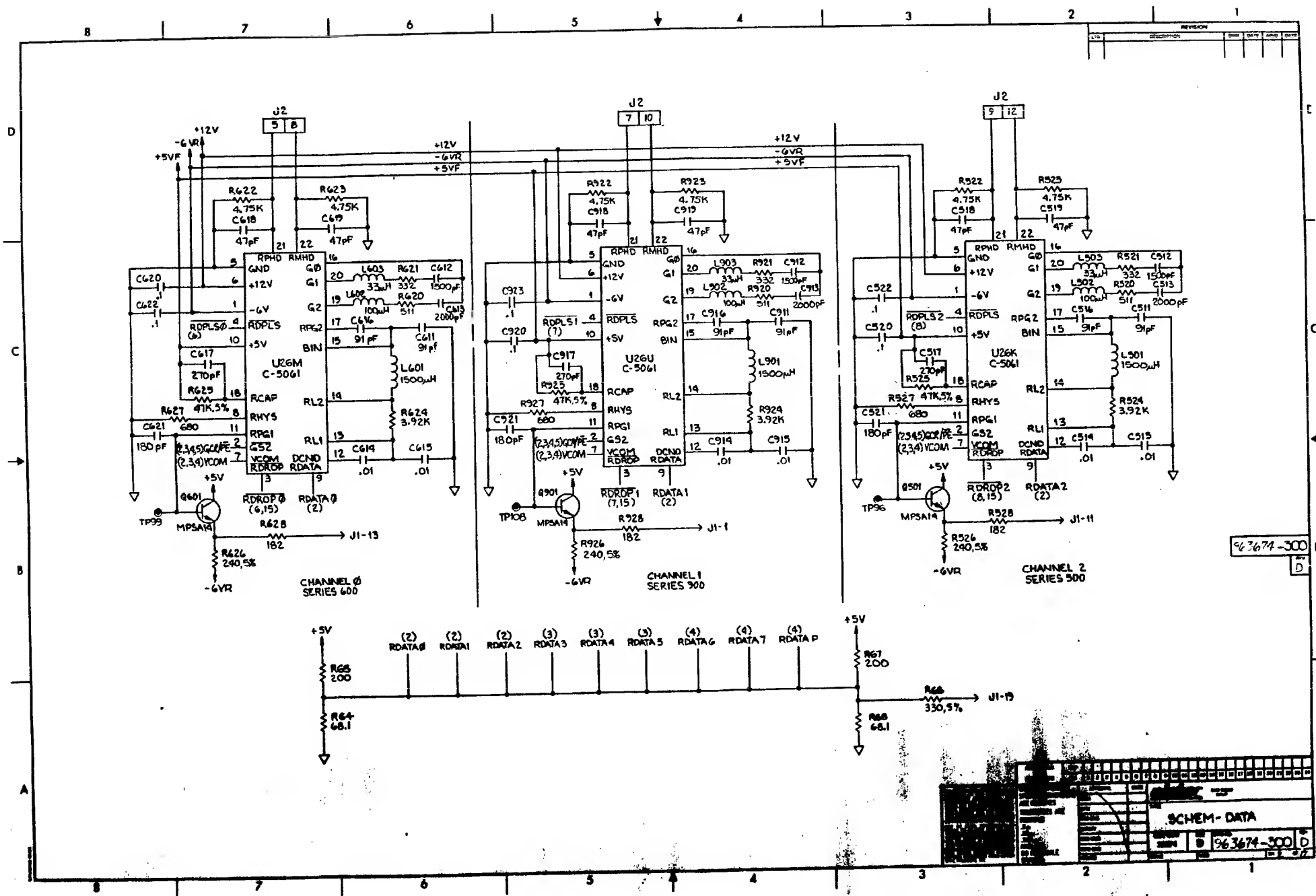
- ALL RESISTORS 1% TO BE 1/8W, ALL 5% TO BE 1/4W
- X = SERIES NO. (100-300) IN WHICH THE COMPONENTS APPEARS
- ALL INDUCTORS ARE IN MICROHENRYS.
- ALL CAPACITORS ARE IN MICROFARADS.

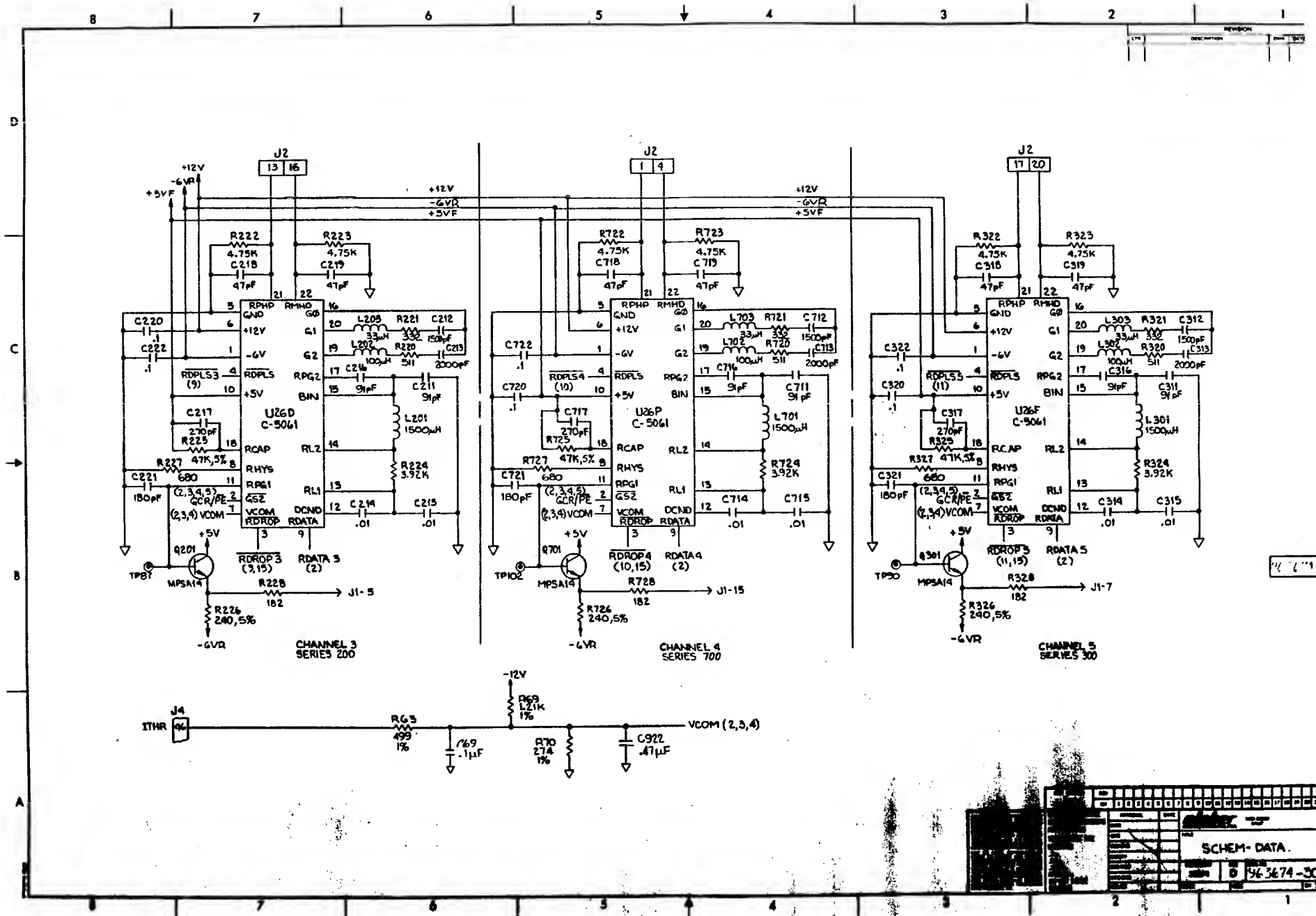
NOTES: UNLESS OTHERWISE SPECIFIED

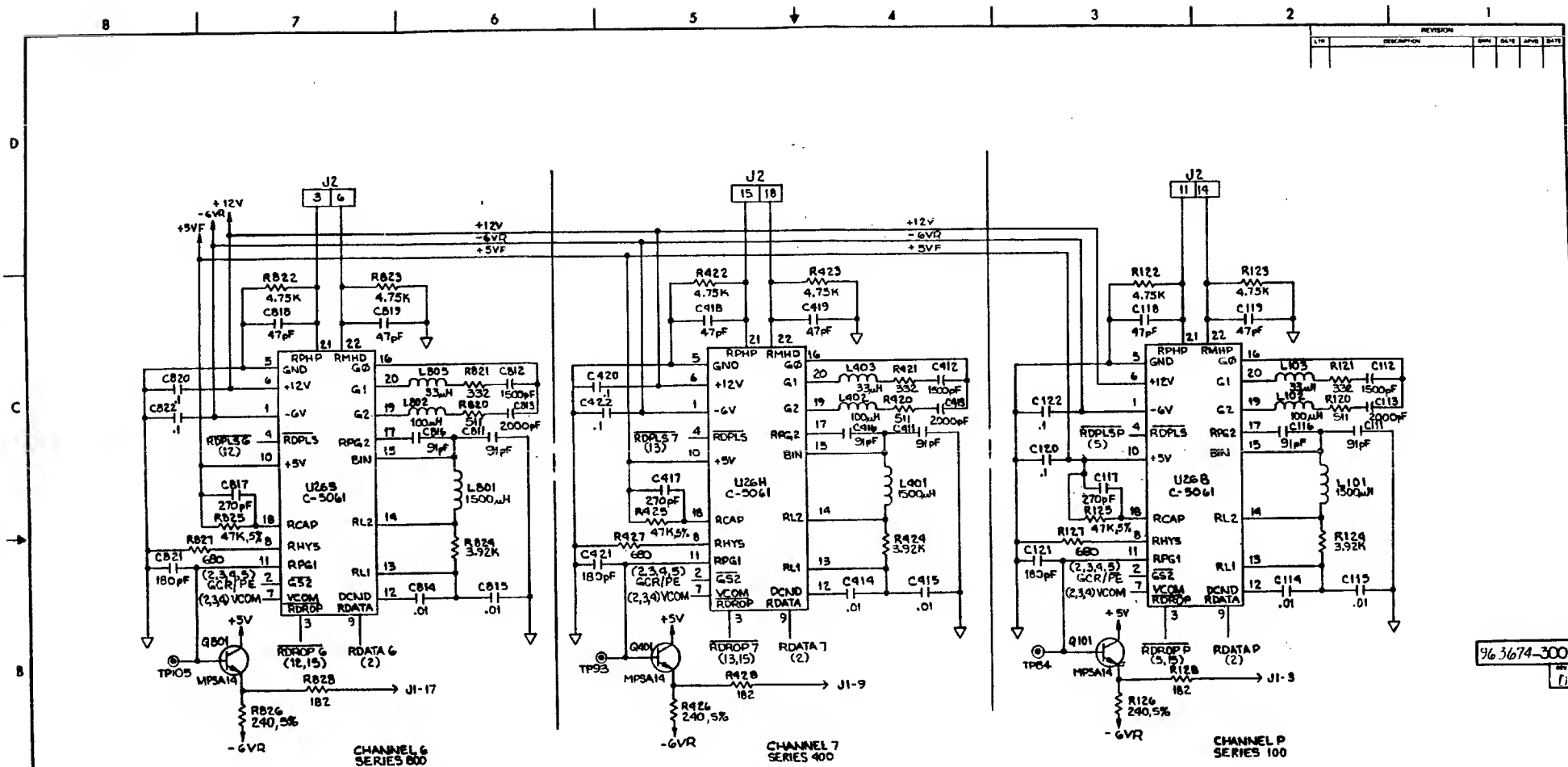


SCHEM-DATA

963674-300







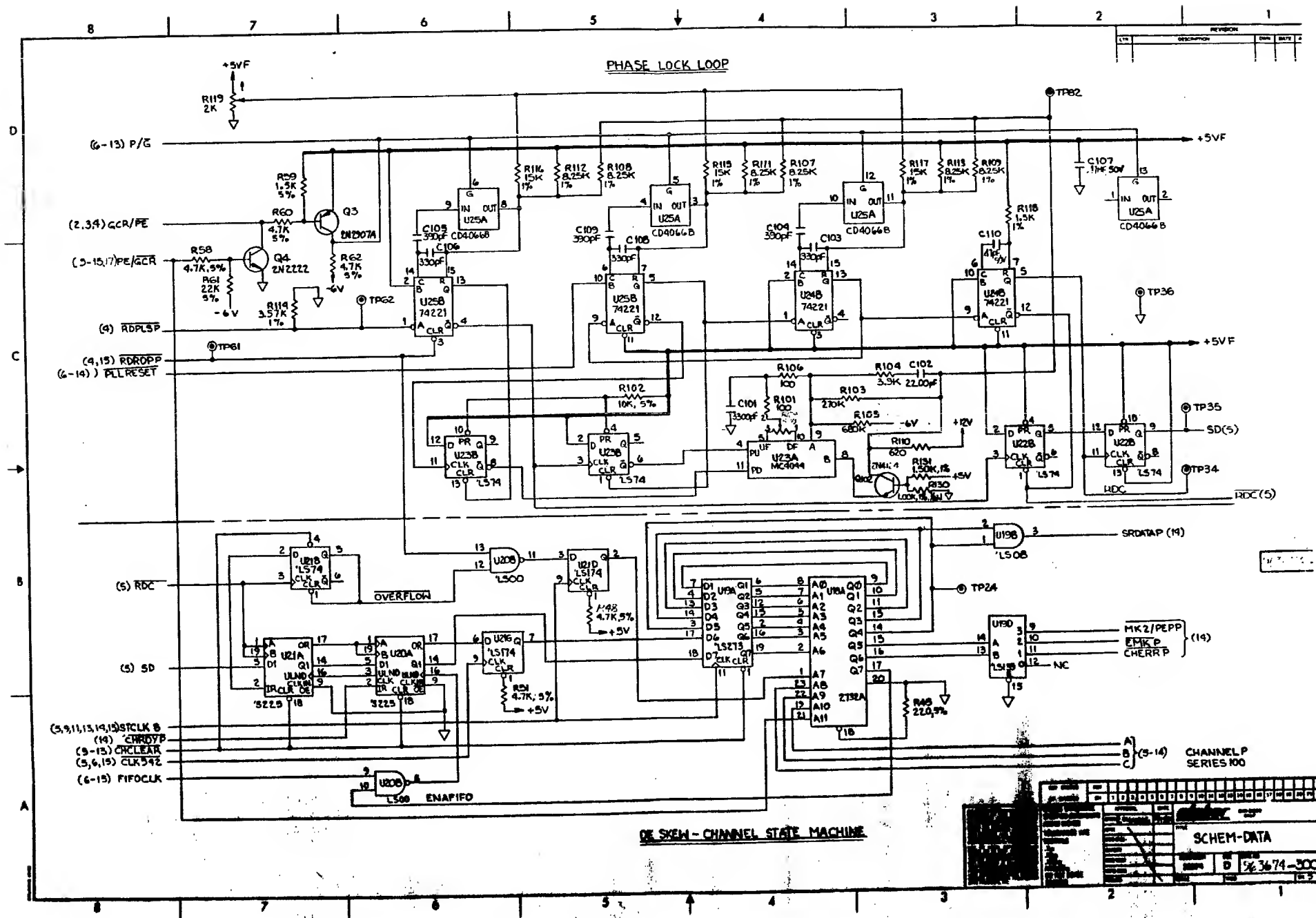
963674-300

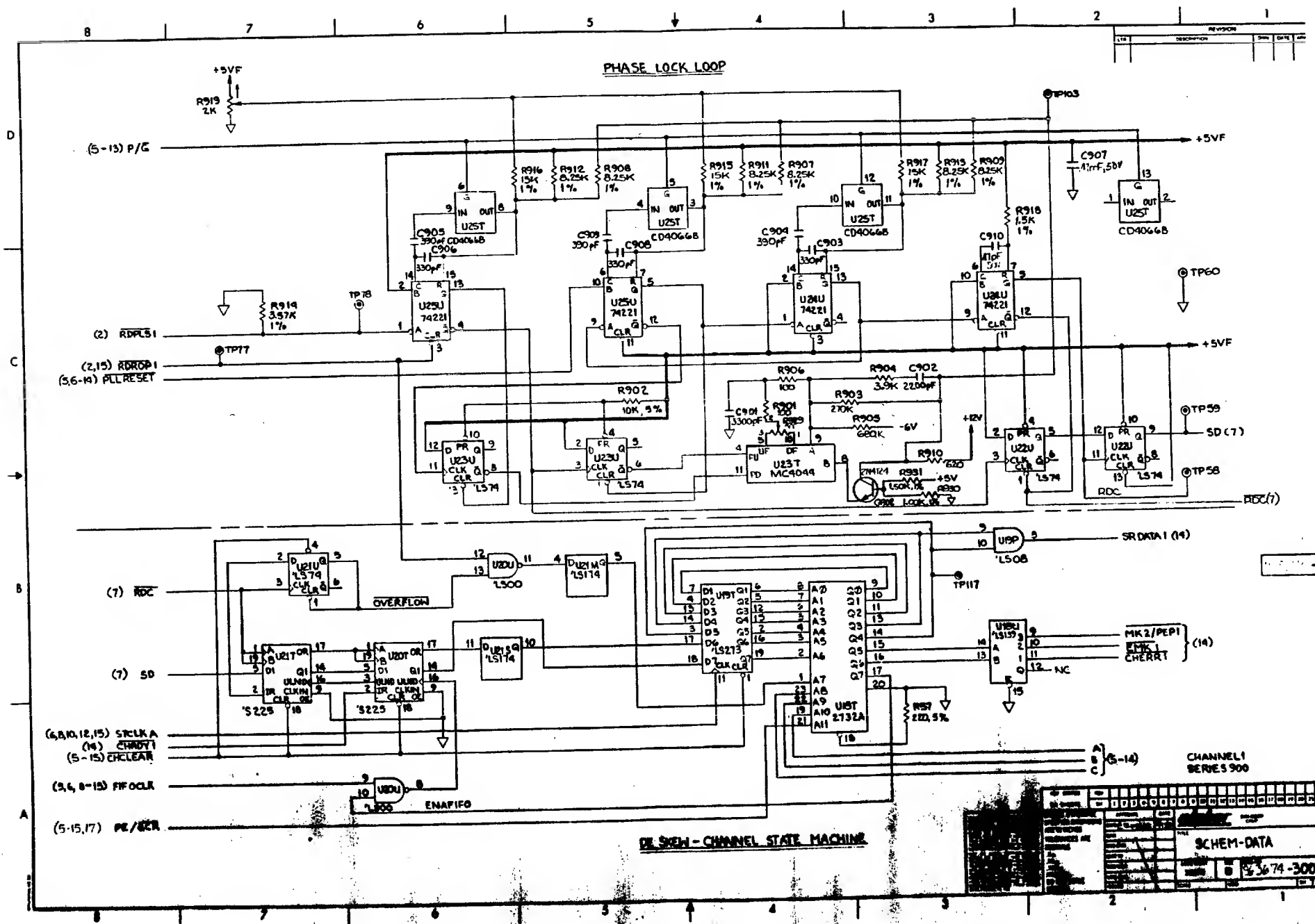
1

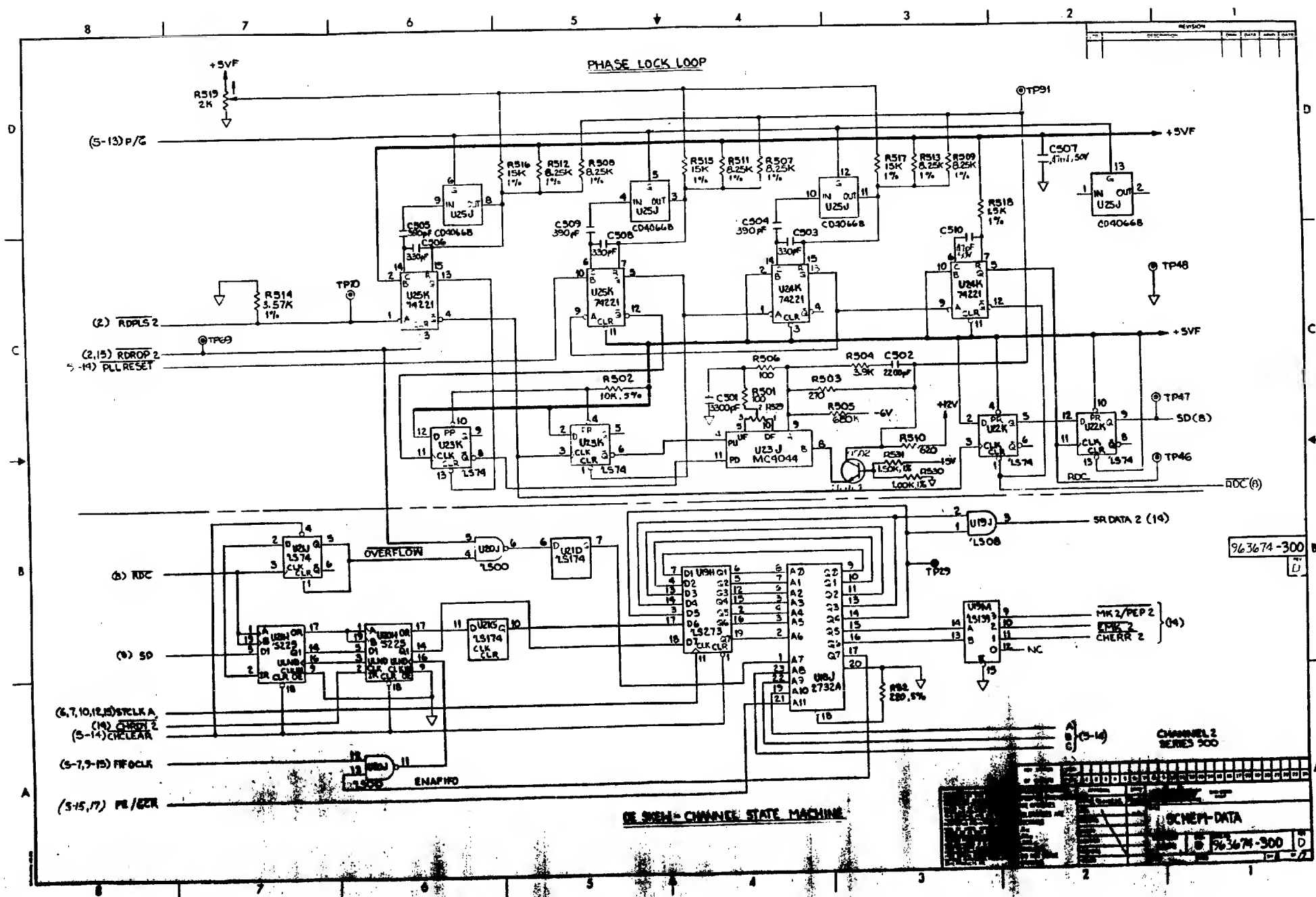
SCHEM DATA

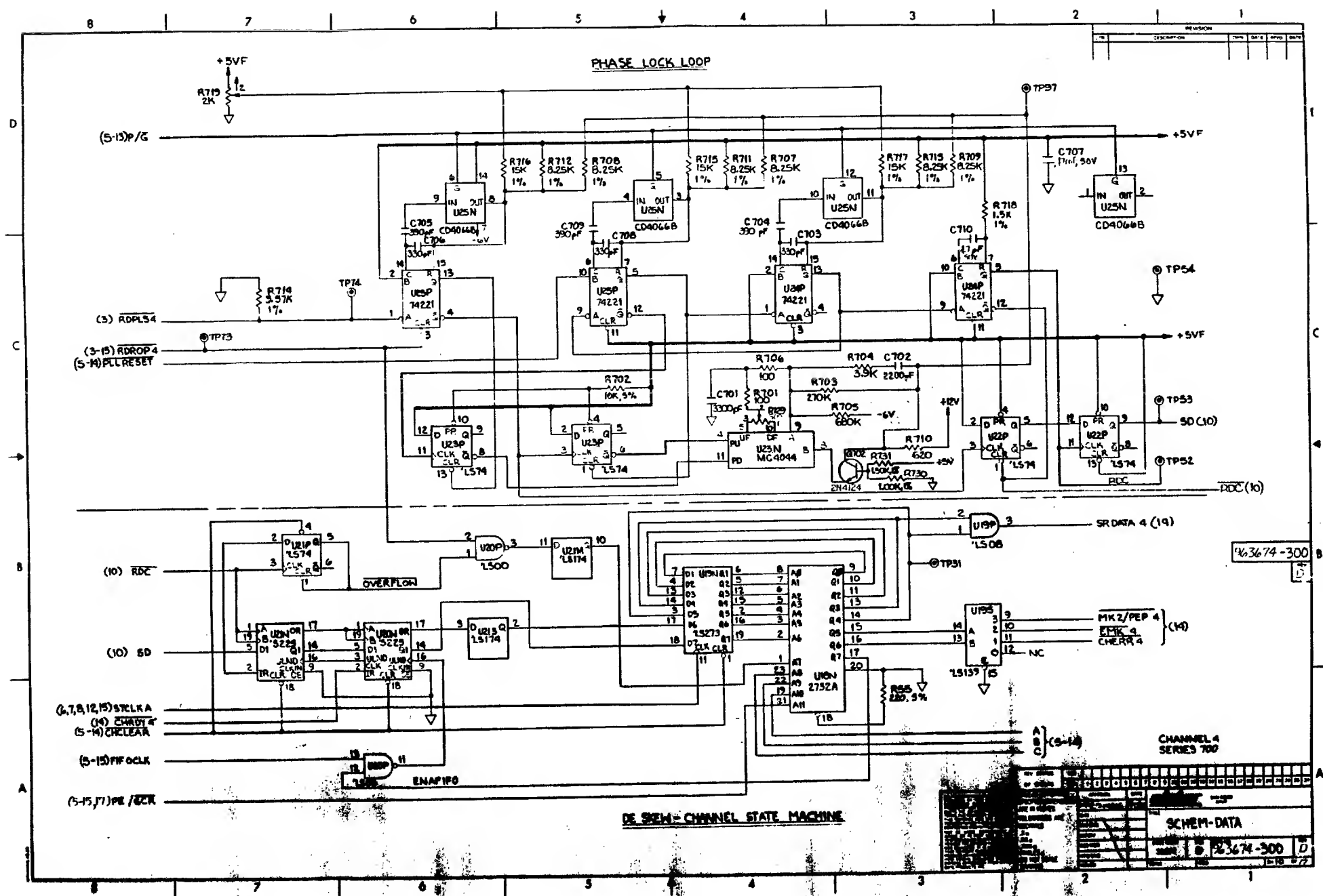
963674-300 D

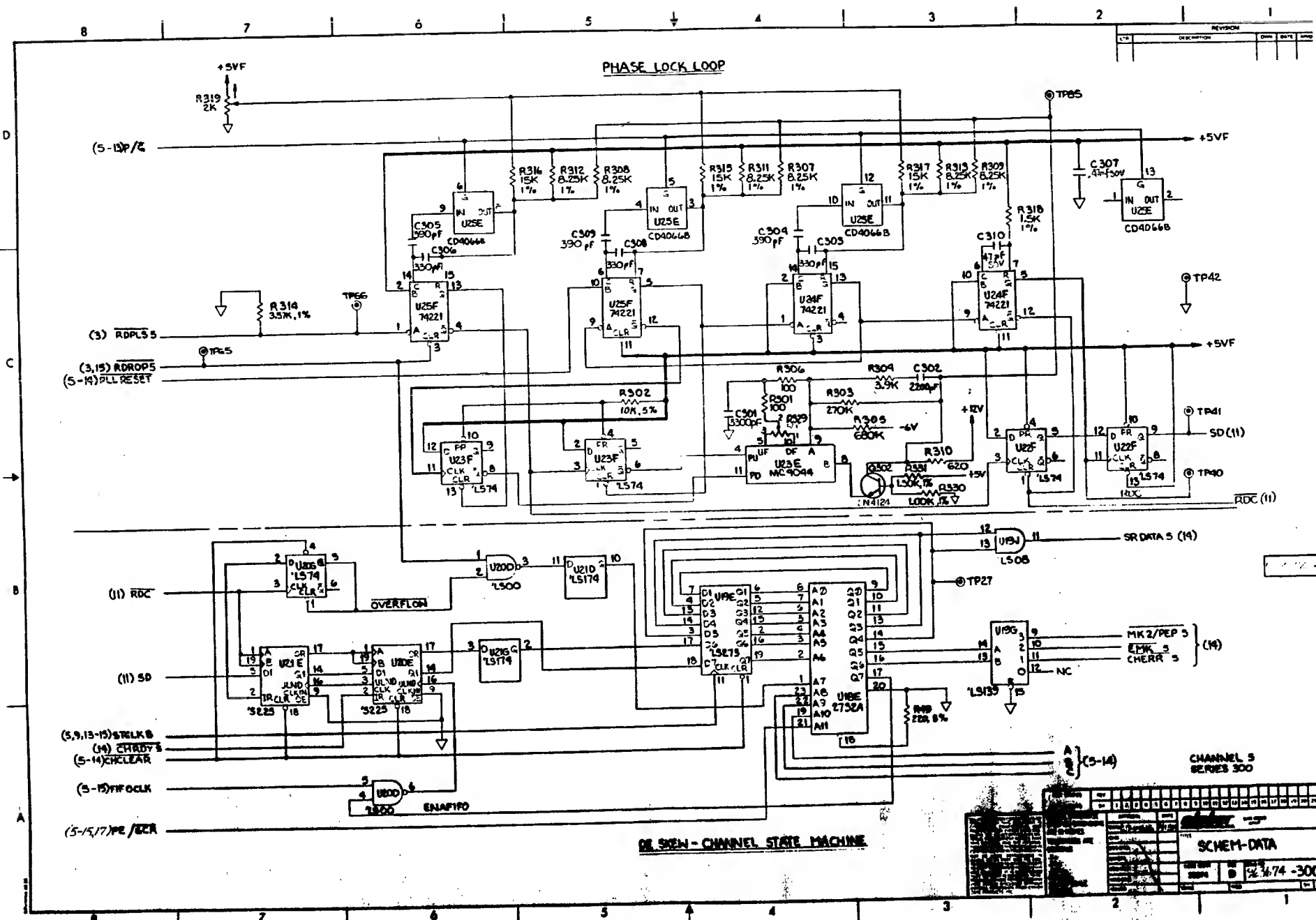
102 077









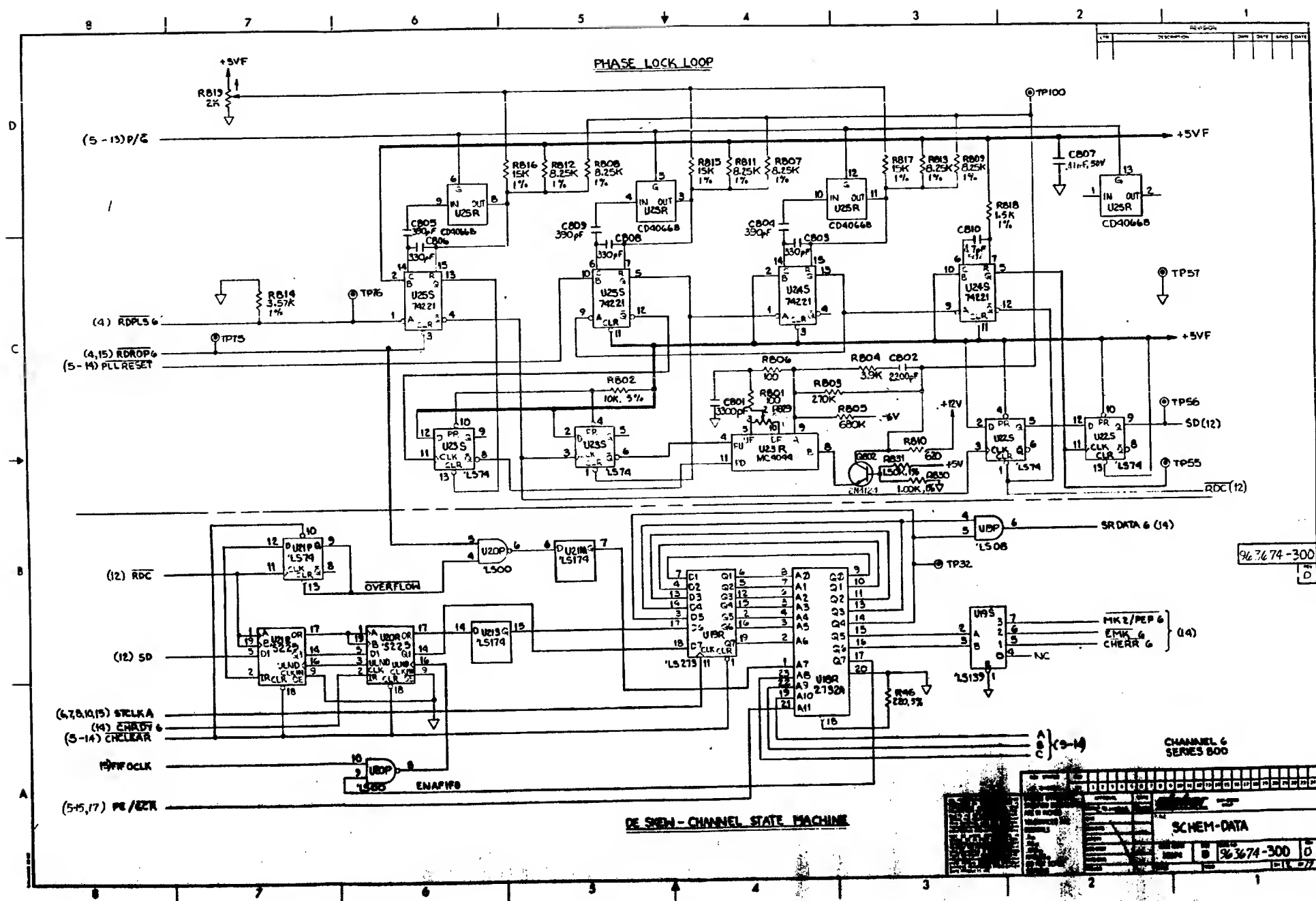


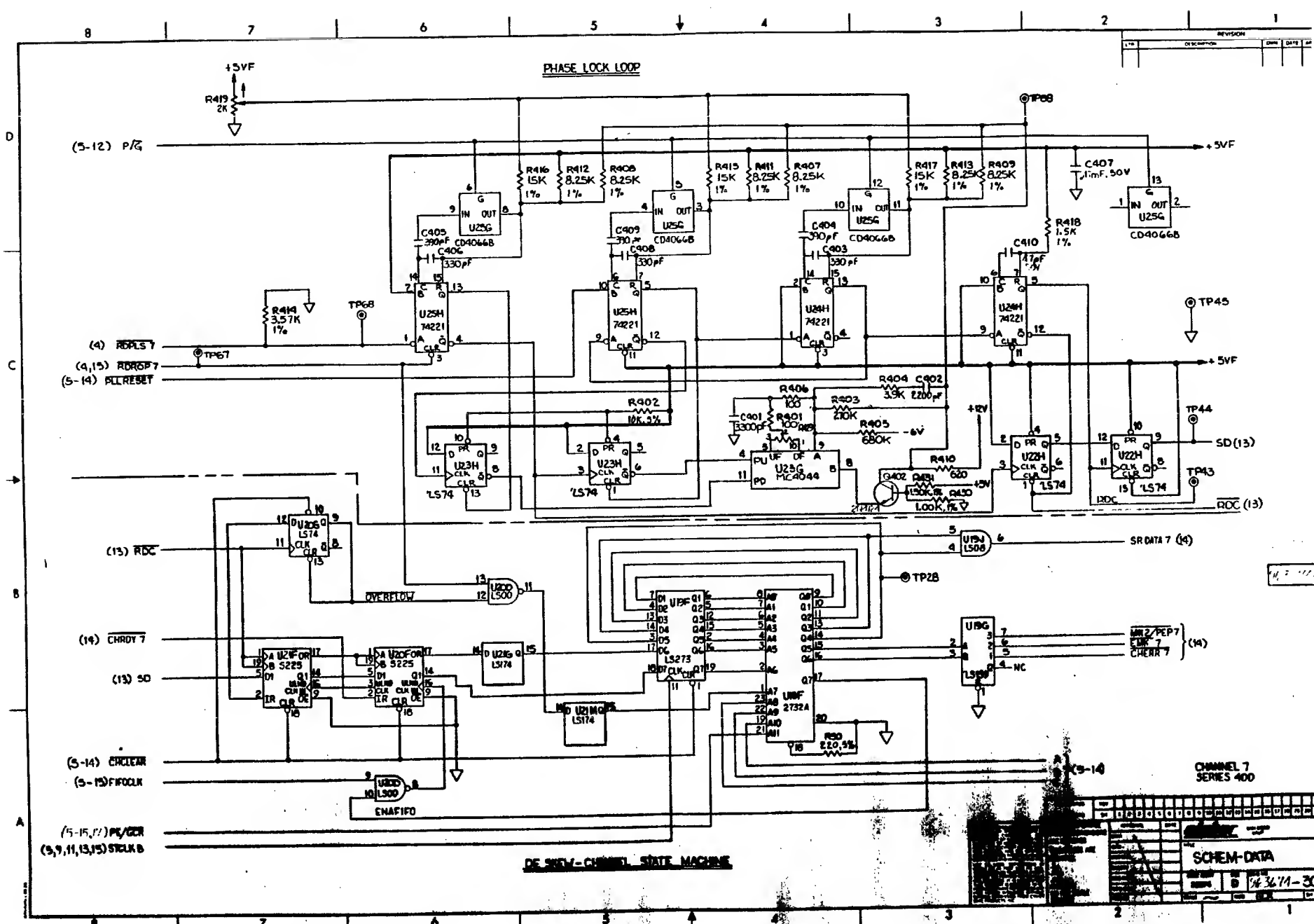
REV	DESCRIPTION	DATE	BY
1			

CHANNEL 5
SERIES 300

SCHEM-DATA

DATE: 10/17/74
BY: J. A. 474-300

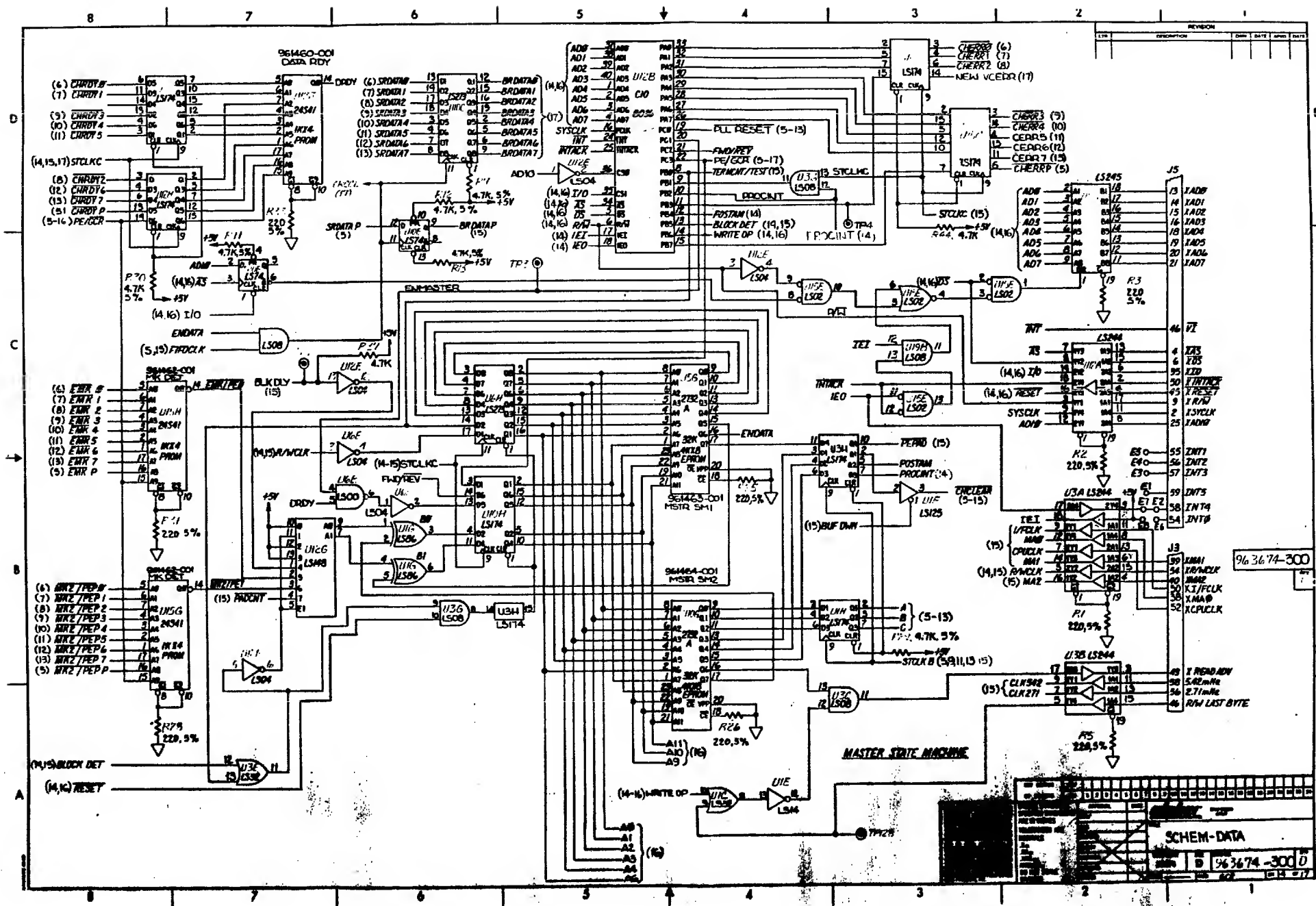


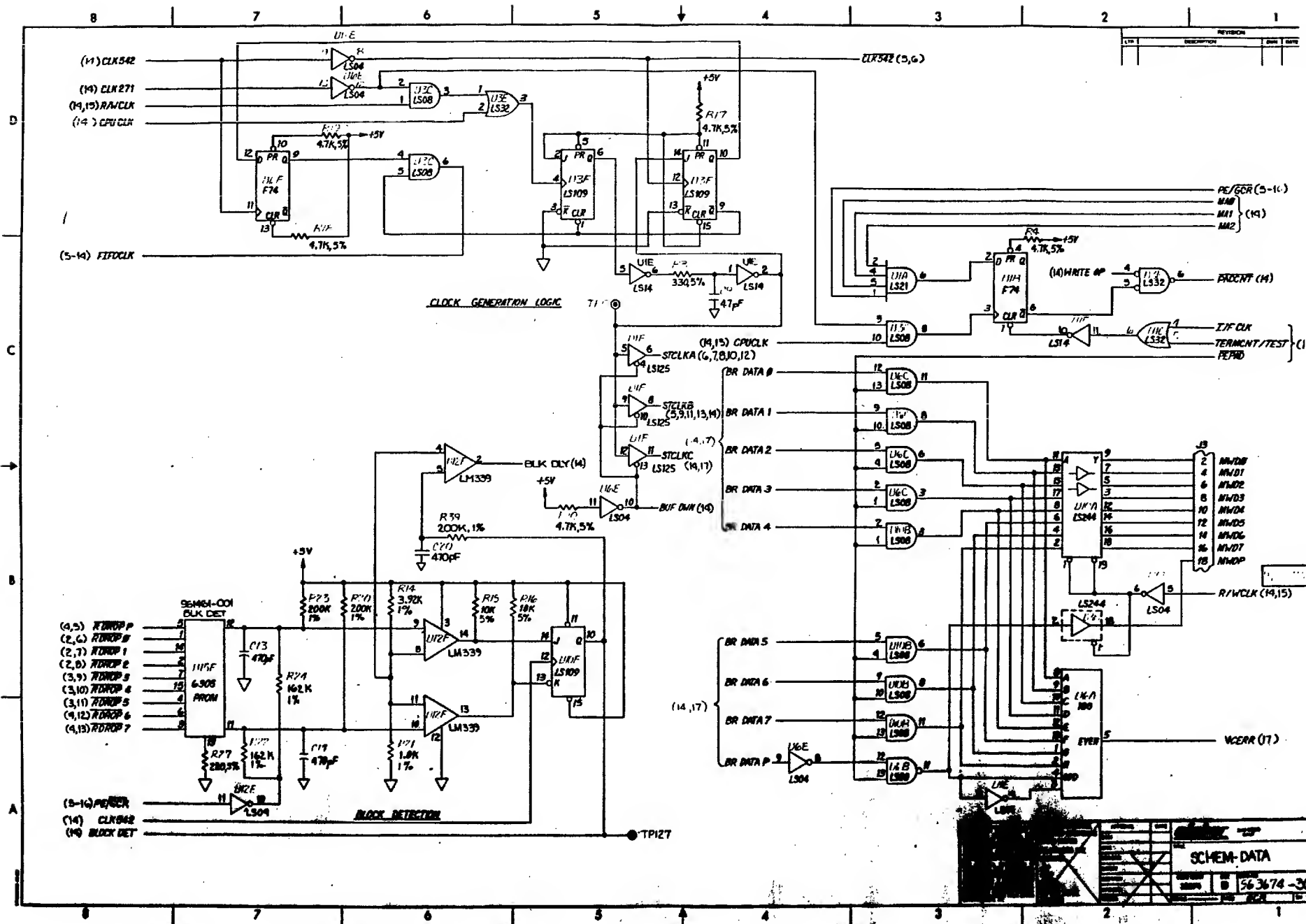


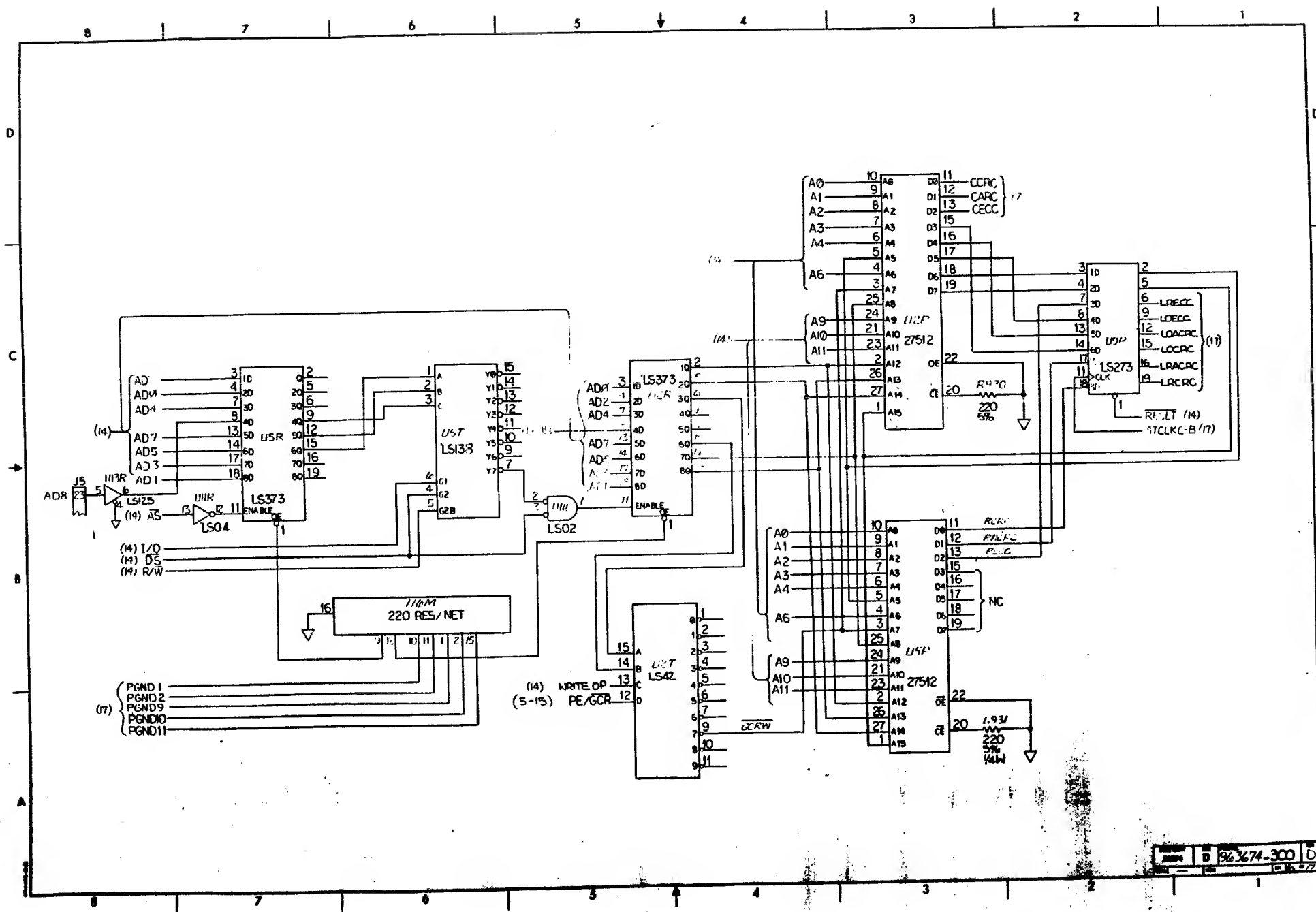
CHANNEL 7
SERIES 400

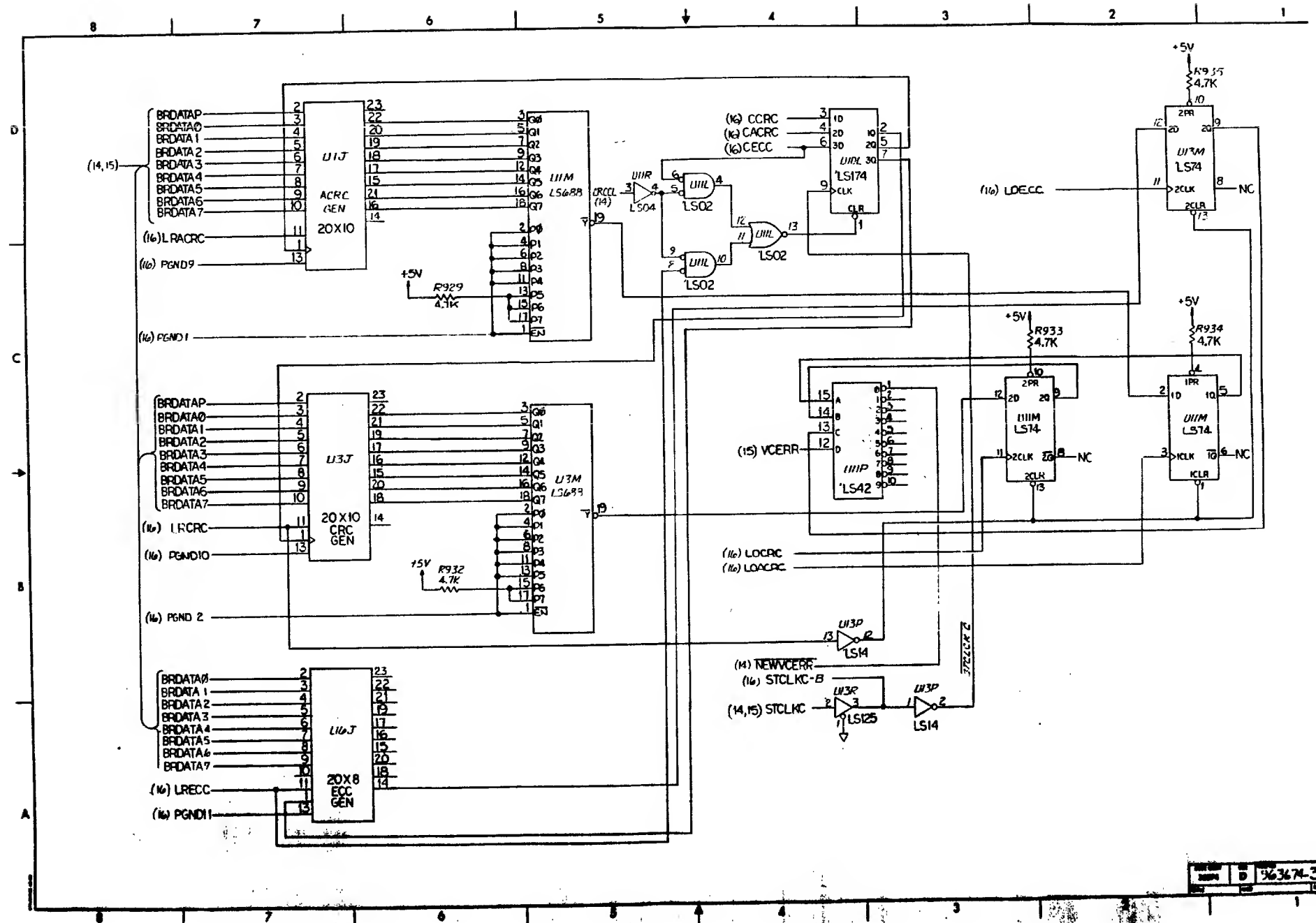
SCHEM-DATA

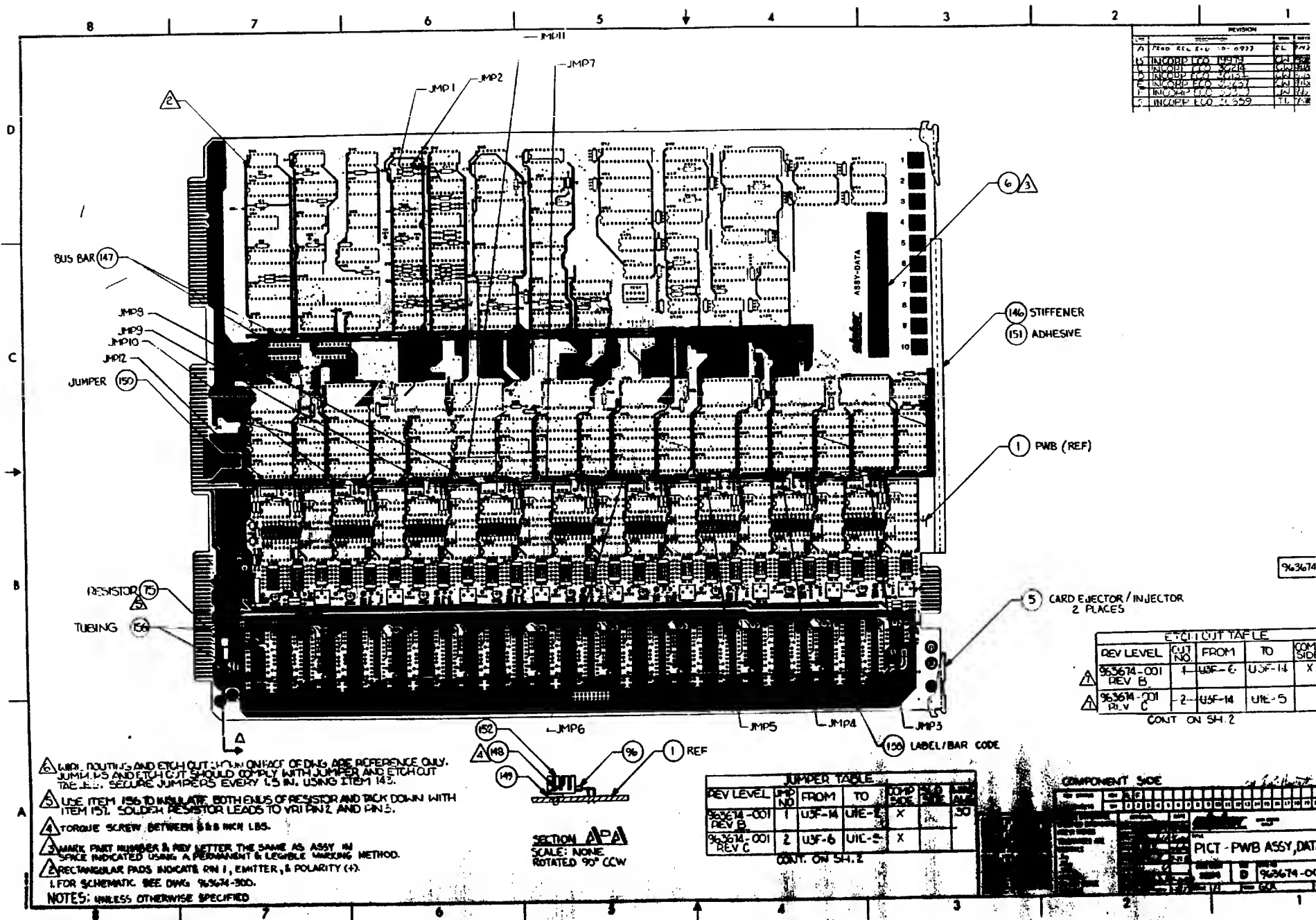
1/6 3/74-30











8

7

6

5

4

3

2

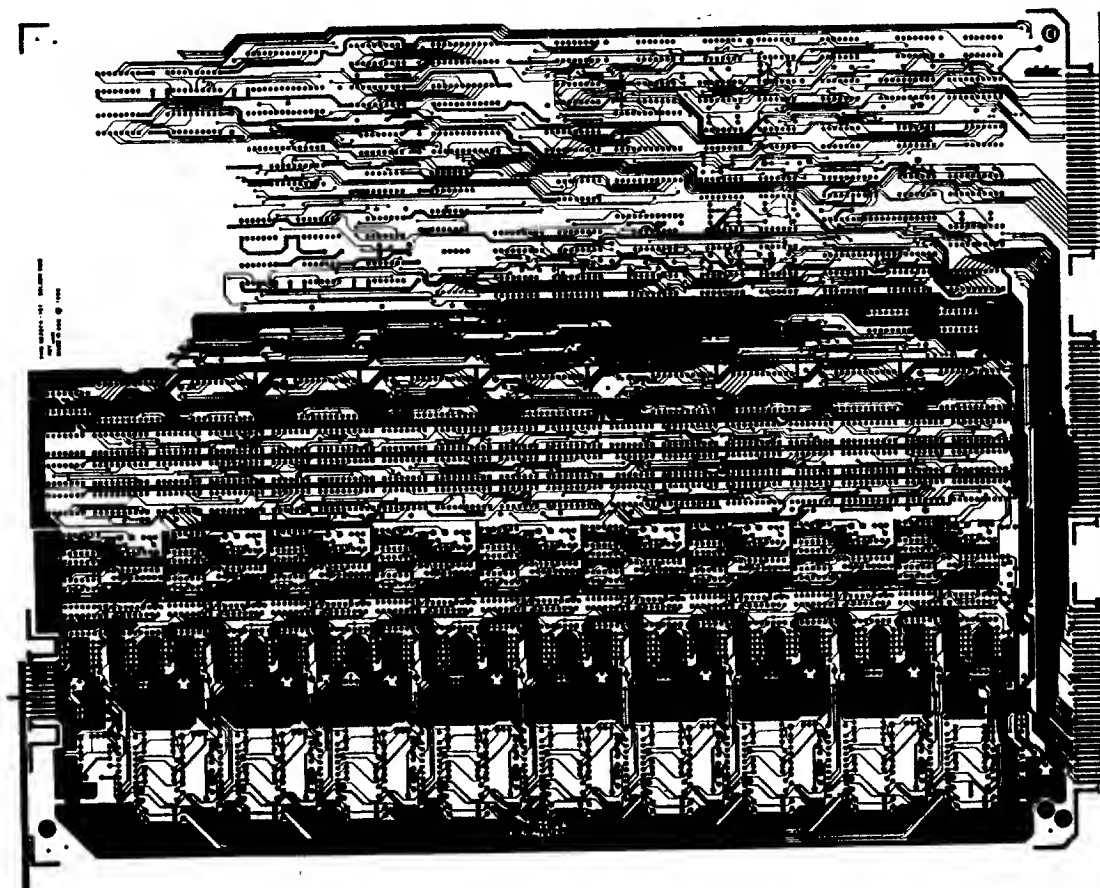
1

D

C

B

A



ETCH CUT TABLE						
REV LEVEL	CUT NO.	FROM	TO	COMP SIDE	SOLD SIDE	
963674-001 REV E	3	TP58	U21T-1	X		
	4	TP59	U21R-1	X		
	5	TP60	U21N-1	X		
	6	TP61	U21L-1	X		
	7	TP62	U21H-1	X		
	8	TP63	U21F-1	X		
	9	TP64	U21E-1	X		
	10	TP65	U21D-1	X		
	11	U20G-11	U21A-1	X		
	12	TP66	U21A-1		X	

JUMPER TABLE						
REV LEVEL	JMP NO.	FROM	TO	COMP SIDE	SOLD SIDE	WIRE AWG
963674-001 REV E	3	U22U-1	U21T-1	X		
	4	U22V-1	U21R-1	X		
	5	U22W-1	U21N-1	X		
	6	U22X-1	U21L-1	X		
	7	U22Y-1	U21H-1	X		
	8	U22Z-1	U21F-1	X		
	9	U22A-1	U21E-1	X		
	10	U22B-1	U21D-1	X		
	11	U20G-11	U21A-1	X		
	12	U22C-1	U21A-1	X		

△ THESE INCDPP HAVE BEEN MADE TO AIN 963674-100 COMP SIDE REV C, AND SOLDER SIDE REV C AND MUST ALSO BE MADE TO MASTER A/N AT NEXT UPDATE.

963674-000 E

L1,200,2.MDATAB01 CIPHER - SAN DIEGO - PRODUCTION DATA BASE
 FRI, AUG 19, 1988

DISTRIBUTION: ANNE - ANNE

PAGE NO: 1

BILL OF MATERIAL

 AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 DPCODE: 4 REV: L PWB ASSY-DATA
 MODEL:
 ECO NO: 30797
 DATE OF LAST ECO: 8/19/88

DP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/D PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P RU	ITEM ND.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963674-101	DRILL-PWB DATA	1 B	1	1.000	1.000	EA	B	Y N	1.000	0	0		00/00/00	99/99/99
963674-000	PICT-PWB DATA	3 G	2	0.000	1.000	EA	F	Y N	0.000	0	0		5/12/86	99/99/99
963674-300	SCHEM-PWB DATA	3 D	3	0.000	1.000	EA	F	Y N	0.000	0	0		5/12/86	99/99/99
970083-001	INJECTOR/EJECTOR-1/16"	3 B	5	2.000	1.000	EA	B	N N	2.000	0	0		00/00/00	99/99/99
731006-800	LABEL-ASSY	3 B	6	1.000	1.000	EA	F	N N	1.000	0	0		00/00/00	99/99/99
970267-001	PIN-TEST,.040SQ X .360LG	3 A	7	74.000	1.000	EA	F	Y N	74.000	0	0	TP1-6,24-6 1,63,65,67 69,71,73,7 5,79-82,84 85,87,88,9 0,91,93,94 96,97,99,1 00,102,103 105,108,11 0,117,127, 128	5/12/86	99/99/99
970961-020	CONN-LOCK/EJECT,20POS,.100CTRS	3 B	8	1.000	1.000	EA	B	Y N	1.000	0	0	J2 ECO#195 00	7/24/87	99/99/99
201204-334	CAP-CER,3300PF,50V,5%,NPD	3 R	14	9.000	1.000	EA	B	Y N	9.000	0	0	C101,201,3 01,401,501 ,601,701,8 01,901	10/10/85	99/99/99
970784-104	CAP-CER,.1UF,50V,-20+80%,AX,*	3 E	15	72.000	1.000	EA	B	Y N	72.000	0	0	C1-8,10-12 ,15-19,22, 44-64,69,1 20,220,320 ,420,520,6 20,720,820 ,920,122,2 22,322,422 ,522,622,7 22,822,923 ,928-942 ECO#30287	1/22/88	99/99/99
201114-105	CAP-CER,10000PF,50V,10%,X7R	3 J	16	18.000	1.000	EA	B	N N	20.000	0	0	C114,214,3 14,414,514 ,614,714,8 14,914,115 ,215,315,4 15,515,615 ,715,815,9	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 2

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
MODEL:
ECO NO: 30797
DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201114-105	CAP-CER,10000PF,50V,10%,X7R	3 J	16	18.000	1.000	EA	B	N N	20.000	0	0 15	00/00/00	99/99/99
201171-100	CAP-ELEC,10MF,50V,	3 M	17	2.000	1.000	EA	B	Y N	2.000	0	0 C43,68	1/22/88	99/99/99
201204-472	CAP-CER,47PF,50V,5%,NPO	3 R	18	28.000	1.000	EA	B	Y N	28.000	0	0 C9,118,218 ECO#30287 ,318,418,5 18,618,718 ,818,918,1 19,219,319 ,419,519,6 19,719,819 ,919,110,2 10,310,410 ,510,610,7 10,810,910 ECO#30287	1/22/88	99/99/99
201160-680	CAP-TANT,6.8MF,35V,10%	3 F	19	1.000	1.000	EA	B	N N	1.000	0	0 C67	00/00/00	99/99/99
201204-912	CAP-CER,91.0PF,50V,5%,NPO	3 R	20	18.000	1.000	EA	B	N N	18.000	0	0 C111,211,3 11,411,511 ,611,711,8 11,911,116 ,216,316,4 16,516,616 ,716,816,9 16	00/00/00	99/99/99
201204-183	CAP-CER,180PF,50V,5%,NPO	3 R	21	9.000	1.000	EA	B	N N	9.000	0	0 C121,221,3 21,421,521 ,621,721,8 21,921	00/00/00	99/99/99
201204-273	CAP-CER,270PF,50V,5%,NPO	3 R	22	9.000	1.000	EA	B	N N	9.000	0	0 C117,217,3 17,417,517 ,617,717,8 17,917	00/00/00	99/99/99
201204-473	CAP-CER,470PF,50V,5%,NPO	3 R	23	3.000	1.000	EA	B	N N	2.000	0	0 C13,14,20	00/00/00	99/99/99
201204-393	CAP-CER,390PF,50V,5%,NPO	3 R	24	27.000	1.000	EA	B	Y N	27.000	0	0 C104,204,3 04,404,504 ,604,704,8 04,904,105 ,205,305,4 05,505,605 ,705,805,9 05,109,209	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
MODEL:
ECO NO: 30797
DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER /	DESCRIPTION	O P R V	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201204-393	CAP-CER,390PF,50V,5%,NPO	3 R	24	27.000	1.000	EA	B	Y N	27.000	0	0	,309,409,5 09,609,709 ,809,909	00/00/00	99/99/99
201204-154	CAP-CER,1500PF,50V,5%,NPO	3 R	25	9.000	1.000	EA	B	N N	9.000	0	0	C112,212,3 12,412,512 ,612,712,8 12,912	00/00/00	99/99/99
201204-204	CAP-CER,2000PF,50V,5%,NPO	3 R	26	9.000	1.000	EA	B	N N	9.000	0	0	C113,213,3 13,413,513 ,613,713,8 13,913	00/00/00	99/99/99
201204-333	CAP-CER,330PF,50V,5%,NPO	3 R	27	27.000	1.000	EA	B	Y N	27.000	0	0	C103,203,3 03,403,503 ,603,703,8 03,903,106 206,306,40 6,506,606, 706,806,90 6,108,208, 308,408,50 8,608,708, 808,908	00/00/00	99/99/99
201204-224	CAP-CER,2200PF,50V,5%,NPO	3 R	28	9.000	1.000	EA	B	Y N	9.000	0	0	C102,202,3 02,402,502 ,602,702,8 02,902	00/00/00	99/99/99
201105-474	CAP-CER,.47MF,50V,10%	3 N	29	11.000	1.000	EA	B	Y N	11.000	0	0	C70,107,20 7,307,407, 507,607,70 7,807,907, 922 ECO#30287	1/22/88	99/99/99
970155-002	INDUCTOR-1.0UH +-10%,	3 J	34	1.000	1.000	EA	B	N N	1.000	0	0	L1	00/00/00	99/99/99
970155-133	INDUCTOR-33UH,+-10%	3 J	35	9.000	1.000	EA	B	N N	9.000	0	0	L103,203,3 03,403,503 ,603,703,8 03,903	00/00/00	99/99/99
970155-200	INDUCTOR-100UH,+-10%	3 J	36	9.000	1.000	EA	B	N N	9.000	0	0	L102,202,3 02,402,502 ,602,702,8 02,902	00/00/00	99/99/99

ORIGINAL

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 4

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 UPCODE: 4 REV: L PWB ASSY-DATA
MODEL:
ECO NO: 30797
DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
REQ: N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
970155-901	INDUCTOR-1500UH +/-10%,	3	J	37	9.000	1.000	EA	B	N	N	9.000	0	0 L101,201,3 01,401,501 601,701,8 01,901	00/00/00	99/99/99
970854-001	TRANSISTOR-2N4124,NPN,TO-92	3	A	38	9.000	1.000	EA	B	Y	N	9.000	0	0 Q102,202,3 02,402,502 602,702,80 2,902	5/12/86	99/99/99
970249-001	TRANSISTOR-PNP,SILICON,	3	C	39	1.000	1.000	EA	B	N	N	1.000	0	0 Q3	00/00/00	99/99/99
204010-533	TRANSISTOR-NPN,SILICON	3	F	40	9.000	1.000	EA	B	Y	N	9.000	0	0 Q101,201,3 01,401,501 601,701,80 1,901	11/04/86	99/99/99
204007-500	TRANSISTOR-NPN SILICON	3	J	41	1.000	1.000	EA	B	Y	N	1.000	0	0 Q4	5/12/86	99/99/99
200012-511	RES-511 OHM 1/4W 1% FF	3	R	42	9.000	1.000	EA	B	N	N	9.000	0	0 R120,220,3 20,420,520 620,720,8 20,920	00/00/00	99/99/99
200200-501	RES-POT,500 OHM CERMET	3	C	44	9.000	1.000	EA	B	Y	N	9.000	0	0 R129,229,3 29,429,529 629,729,8 29,929	00/00/00	99/99/99
200214-202	RES-POT,2K	3	D	47	9.000	1.000	EA	B	Y	N	9.000	0	0 R119,219,3 19,419,519 619,719,8 19,919	3/27/86	99/99/99
200075-680	RES-680 KOHM 1/4W 5% CF	3	AC	48	9.000	1.000	EA	F	Y	N	9.000	0	0 R105,205,3 05,405,505 605,705,8 05,905	00/00/00	99/99/99
200011-681	RES-68.1 OHM 1/4W 1% FF	3	R	49	2.000	1.000	EA	B	N	N	2.000	0	0 R64,68	00/00/00	99/99/99
200072-680	RES-680 OHM 1/4W 5% CF	3	AC	50	9.000	1.000	EA	F	Y	N	9.000	0	0 R127,227,3 27,427,527 627,727,8 27,927	00/00/00	99/99/99
200012-332	RES-332 OHM 1/4W 1% FF	3	P	51	9.000	1.000	EA	B	N	N	9.000	0	0 R121,221,3 21,421,521 621,721,8 21,921	00/00/00	99/99/99
200012-182	RES-182 OHM 1/4W 1% FF	3	R	52	9.000	1.000	EA	B	N	N	9.000	0	0 R128,228,3 28,428,528	00/00/00	99/99/99

VAL

BILL OF MATERIAL

 AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY
 963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
 MODEL:
 ECO NO: 30797
 DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	R V	ITEM NO.	QTY ASSEMBLY	PER YIELD	FACTR	UM	SC	R E P O F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200012-182	RES-182 OHM 1/4W 1% FF	3	R	52	9.000	1.000	EA	B	N	N	9.000	0	0	0	,628,728,8 28,928,	00/00/00 99/99/99
200012-200	RES-200 OHM 1/4W 1% FF	3	R	53	2.000	1.000	EA	B	N	N	11.000	0	0	0	R65,67	00/00/00 99/99/99
200012-499	RES-499 OHM 1/4W 1% FF	3	R	54	1.000	1.000	EA	B	Y	N	1.000	0	0	0	R63	00/00/00 99/99/99
200012-274	RES-274 OHM 1/4W 1% FF	3	R	55	1.000	1.000	EA	B	Y	N	19.000	0	0	0	R70	10/10/85 99/99/99
200072-330	RES-330 OHM 1/4W 5% CF	3	AC	56	2.000	1.000	EA	F	Y	N	2.000	0	0	0	R8,66	5/19/86 99/99/99
200013-121	RES-1.21 KOHM 1/4W 1% FF	3	R	57	1.000	1.000	EA	B	Y	N	1.000	0	0	0	R69	10/10/85 99/99/99
200014-150	RES-15.0 KOHM 1/4W 1% FF	3	R	59	27.000	1.000	EA	F	Y	N	27.000	0	0	0	R115,215,3 15,415,515 ,615,715,8 15,915,116 ,216,316,4 16,516,616 ,716,816,9 16,117,217 ,317,417,5 17,617,717 ,817,917	10/10/85 99/99/99
200013-825	RES-8.25 KOHM 1/4W 1% FF	3	R	60	54.000	1.000	EA	F	Y	N	54.000	0	0	0	R107,207,3 07,407,507 ,607,707,8 07,907,108 ,208,308,4 08,508,608 ,708,808,9 08,109,209 ,309,409,5 09,609,709 ,809,909, 111,211,31 1,411,511, 611,711,81 1,911,112, 212,312,41 2,512,612, 712,812,91 2,113,213, 313,413,51 3,613,713, 813,913	10/10/85 99/99/99
200013-100	RES-1.00 KOHM 1/4W 1% FF	3	R	61	10.000	1.000	EA	F	Y	N	10.000	0	0	0	R21,130,29	00/00/00 99/99/99

ORIGINAL

LI,200,2.MDATAB01 CIPHER - SAN DIEGO - PRODUCTION DATA BASE
FRI, AUG 19, 1988

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 6

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
MODEL:
ECO NO: 30797
DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P R U	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P O F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200013-100	RES-1.00 KOHM 1/4W 1% FF	3 R	61	10.000	1.000	EA	F	Y N	10.000	0	0	0,330,430, 530,630,73 0,830,930	00/00/00	99/99/99
200013-150	RES-1.50 KOHM 1/4W 1% FF	3 R	62	18.000	1.000	EA	B	N N	9.000	0	0	R118,218,3 18,418,518 ,618,718,8 18,918,131 ,231,331,4 31,531,631 ,731,831,9 31	00/00/00	99/99/99
200073-270	RES-2.7 KOHM 1/4W 5% CF	3 AC	64	9.000	1.000	EA	F	Y N	9.000	0	0	R126,226,3 ,26,426,526 626,726,82 6,926	11/04/86	99/99/99
200013-357	RES-3.57 KOHM 1/4W 1% FF	3 R	65	9.000	1.000	EA	B	N N	9.000	0	0	R114,214,3 14,414,514 ,614,714,8 14,914	00/00/00	99/99/99
200013-392	RES-3.92 KOHM 1/4W 1% FF	3 R	68	10.000	1.000	EA	F	N N	10.000	0	0	R14,124,22 4,324,424, 524,624,72 4,824,924	00/00/00	99/99/99
200013-475	RES-4.75 KOHM 1/4W 1% FF	3 R	69	18.000	1.000	EA	F	N N	45.000	0	0	R122,222,3 22,422,522 ,622,722,8 22,922,123 ,223,323,4 23,523,623 ,723,823,9 23	00/00/00	99/99/99
200073-390	RES-3.9 KOHM 1/4W 5% CF	3 AC	70	9.000	1.000	EA	F	Y N	9.000	0	0	R104,204,3 04,404,504 ,604,704,8 04,904	00/00/00	99/99/99
200015-162	RES-162 KOHM 1/4W 1% FF	3 R	73	2.000	1.000	EA	B	N N	2.000	0	0	R22,24	00/00/00	99/99/99
200015-200	RES-200 KOHM 1/4W 1% FF	3 R	74	3.000	1.000	EA	B	N N	2.000	0	0	R20,23,39	00/00/00	99/99/99
971207-001	RES-390HM,5W,5%	3 B	75	1.000	1.000	EA	B	Y N	1.000	0	0	R71 ECO#30 134	3/01/88	99/99/99
200072-100	RES-100 OHM 1/4W 5% CF	3 AC	76	18.000	1.000	EA	F	Y N	18.000	0	0	R101,201,3 01,401,501	10/10/85	99/99/99

BILL OF MATERIAL

 AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
 MODEL:
 ECO NO: 30797
 DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

DATE OF LAST ECU: 07/19/00															
PART NUMBER	DESCRIPTION		O P	ITEM RV NO.	QTY ASSEMBLY	PER YIELD FACTR	UM	SC	R E P O F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200072-100	RES-100	OHM 1/4W 5% CF	3	AC	76	18.000	1.000	EA F	Y N	18.000	0	0	,601,701,8 01,901,106 ,206,306,4 06,506,606 ,706,806,9 06	10/10/85	99/99/99
200075-270	RES-270	KOHM 1/4W 5% CF	3	AC	77	9.000	1.000	EA F	Y N	9.000	0	0	R103,203,3 03,403,503 ,603,703,8 03,903	10/10/85	99/99/99
200072-620	RES-620	OHM 1/4W 5% CF	3	AC	78	9.000	1.000	EA F	Y N	9.000	0	0	R110,210,3 10,410,510 ,610,710,8 10,910	10/10/85	99/99/99
200072-220	RES-220	OHM 1/4W 5% CF	3	AC	80	21.000	1.000	EA F	Y N	21.000	0	0	R1-3,5,25- 28,31,33,4 5-47,49,50 52,53,55,5 7,930,931	5/12/86	99/99/99
200073-470	RES-4.7	KOHM 1/4W 5% CF	3	AC	81	25.000	1.000	EA F	Y N	25.000	0	0	R4,7,10-13 17-19,29,3 0,37,44,48 51,54,56,5 8,60,62,92 9,932,933, 934,935	5/12/86	99/99/99
200074-100	RES-10	KOHM 1/4W 5% CF	3	AC	82	11.000	1.000	EA F	Y N	11.000	0	0	R15,16,102 ,202,302,4 02,502,602 ,702,802,9 02	3/27/86	99/99/99
200073-150	RES-1.5	KOHM 1/4W 5% CF	3	AC	83	1.000	1.000	EA F	Y N	1.000	0	0	R59	5/12/86	99/99/99
200074-220	RES-22	KOHM 1/4W 5% CF	3	AC	84	1.000	1.000	EA F	Y N	1.000	0	0	R61	5/12/86	99/99/99
200074-470	RES-47	KOHM 1/4W 5% CF	3	AC	85	9.000	1.000	EA F	Y N	9.000	0	0	R125,225,3 25,425,525 625,725,82 5,925	5/12/86	99/99/99
970345-002	RES-NTWK	220 OHM DIP 16P	3	D	90	1.000	1.000	EA B	Y N	1.000	0	0	U6M	5/19/86	99/99/99
970002-001	IC-7906	VOLT REG -6V	3	A	96	1.000	1.000	EA B	Y N	1.000	0	0	UR1	00/00/00	99/99/99
203007-700	IC-339	VOLT COMP QUAD	3	J	97	1.000	1.000	EA B	N N	1.000	0	0	U12F	00/00/00	99/99/99
961463-001	S/W-GCR,ASSY,RD MSTR		1	A	98	1.000	1.000	EA B	N N	1.000	0	0	U5G	00/00/00	99/99/99

ORIGINAL

ORIGINAL

BILL OF MATERIAL

AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
MODEL:
ECO NO: 30797
DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	ITEM RV	QTY NO.	PER ASSEMBLY	YIELD FACTR	UM	SC	R E P O F	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
961464-001	S/W-GCR,ASSY,RD MSTR	1	A	99	1.000	1.000	EA	B	N	N	1.000	0	0 U10G	00/00/00	99/99/99
961462-001	S/W-GCR,ASSY,MARK	1	B	100	2.000	1.000	EA	B	N	N	2.000	0	0 U15G,15H	00/00/00	99/99/99
961460-001	S/W-GCR,ASSY,DATA READY	1	B	101	1.000	1.000	EA	B	N	N	1.000	0	0 U12J	00/00/00	99/99/99
962865-001	MASKED PROM-32K(4KX8)	3	A	102	9.000	1.000	EA	B	Y	N	9.000	0	0 U18A,18C,1 8E,18F,18J 18L,18N,18 R,18T	12/19/85	99/99/99
203012-999	IC-4044 DET PHASE FREQ	3	C	103	9.000	1.000	EA	B	N	N	9.000	0	0 U23A,23C,2 3E,23G,23J ,23L,23N,2 3R,23T	00/00/00	99/99/99
970367-001	IC-4066 SW BILAT QUAD	3	C	104	9.000	1.000	EA	B	N	N	9.000	0	0 U25A,25C,2 5E,25G,25J ,25L,25N,2 5R,25T	00/00/00	99/99/99
961461-001	S/W-GCR,ASSY,BLOCK	3	A	105	1.000	1.000	EA	B	N	N	1.000	0	0 U15F	00/00/00	99/99/99
203555-111	IC-8036 CIO 16BIT 6MHZ	3	C	106	1.000	1.000	EA	B	N	N	1.000	0	0 U12B	00/00/00	99/99/99
961055-001	SPECIFICATION/ARTWORK-IC	3	C	107	9.000	1.000	EA	B	N	N	9.000	0	0 U26B,26D,2 6F,26H,26K ,26M,26P,2 6S,26U	00/00/00	99/99/99
970221-001	IC-74LS00 NAND 2IN PDS QUAD	3	E	109	6.000	1.000	EA	B	N	N	6.000	0	0 U20B,20D,2 0J,20P,20U ,6B	00/00/00	99/99/99
203081-001	IC-74LS02 NOR 2IN PDS QUAD	3	J	110	2.000	1.000	EA	B	N	N	2.000	0	0 U15E,11L	00/00/00	99/99/99
970011-001	IC-74LS04 INV HEX	3	D	111	3.000	1.000	EA	B	N	N	3.000	0	0 U6E,12E,11 R	00/00/00	99/99/99
970010-001	IC-74LS08 AND 2IN QUAD	3	B	112	7.000	1.000	EA	B	N	N	11.000	0	0 U3C,3G,6C, 10B,19B,19 J,19P	00/00/00	99/99/99
203085-001	IC-74LS14 INV SCHMITT HEX	3	J	113	2.000	1.000	EA	B	N	N	2.000	0	0 U1E,13P	00/00/00	99/99/99
203031-600	IC-74LS21 AND 4IN DUAL	3	E	114	1.000	1.000	EA	B	N	N	1.000	0	0 U1A	00/00/00	99/99/99
203035-032	IC-74LS32 OR 2IN QUAD	3	J	115	2.000	1.000	EA	B	N	N	3.000	0	0 U1C,3E	00/00/00	99/99/99
203039-001	IC-74LS74 FF.D DUAL	3	M	116	26.000	1.000	EA	B	N	N	26.000	0	0 U21B,22B,2 3B,22D,23D ,22S,20G,2 2F,23F,22H ,23H,21J,2 2K,23K,22M ,23M,21P,2 2P,23P,21U	00/00/00	99/99/99

ORIGINAL

BILL OF MATERIAL

 AS OF 12/30/93

CLASS CODE GROUP: 1 UNCLASSIFIED
 CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY
 963674-001 DPCODE: 4 REV: L PWB ASSY-DATA
 MODEL:
 ECO NO: 30797
 DATE OF LAST ECO: 8/19/88

DP: ORDER POLICY CODE
 REQ:N=PART OPTIONAL
 Y=PART REQUIRED
 PF: N=PART DOES NOT PRINT ON SALES ORDER
 Y=PART PRINTS ON SALES ORDER W/O PRICE
 P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	D P	ITEM RV	QTY PER NO. ASSEMBLY	YIELD FACTR	UM	SC	R E P	DEFAULT Q F QUANTITY	DAYS OFF SET	REFERENCE SEQ DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
203039-001	IC-74LS74 FF D DUAL	3	M	116	26.000	1.000	EA B	N N	26.000	0	0 ,22U,23U,1 0E,23S,11M 13M	00/00/00	99/99/99
203042-001	IC-74LS86 XOR QUAD	3	K	117	1.000	1.000	EA B	N N	4.000	0	0 U1G	00/00/00	99/99/99
203094-500	IC-74LS109 FF JK PDS EDGE	3	J	118	2.000	1.000	EA B	N N	2.000	0	0 U3F,10F	00/00/00	99/99/99
203036-039	IC-74LS125 BUS BUF QUAD	3	F	119	2.000	1.000	EA B	N N	2.000	0	0 U1F,13R	00/00/00	99/99/99
203046-156	IC-74LS139 1-4 DUAL	3	G	120	5.000	1.000	EA B	N N	5.000	0	0 U19D,19G,1 9S,,19M,18 U	00/00/00	99/99/99
970364-001	IC-74LS148 8-3 LINE OCT	3	A	121	1.000	1.000	EA B	N N	1.000	0	0 U12G	00/00/00	99/99/99
203051-174	IC-74LS174,FF,D,HEX	3	L	122	12.000	1.000	EA B	Y N	12.000	0	0 U15B,15C,2 10,1H,3H,1 0H,,12H,21 G,21M,21S, 15J,10L EC D#30155	3/07/88	99/99/99
203062-225	IC-74S225 MEM FIFO 16X5 3S	3	C	123	18.000	1.000	EA B	N N	18.000	0	0 U20A,21A,2 0C,21C,20E ,21E,20F,2 1F,20H,21H ,21N,20L,, 20N,21L,20 R,21R,20T, 21T	00/00/00	99/99/99
203052-244	IC-74LS244 BFR OCT 3S	3	L	124	4.000	1.000	EA B	N N	6.000	0	0 10A,12A,3A 3B	00/00/00	99/99/99
203102-273	IC-74LS273 LATCH D OCT	3	C	125	12.000	1.000	EA B	N N	12.000	0	0 U19A,19C,1 0C,19E,19F ,19L,19R,6 H,19H,19N, 19T,9P	00/00/00	99/99/99
970325-001	IC-74F74 FF D DUAL	3	D	126	2.000	1.000	EA B	N N	3.000	0	0 U1B,6F	00/00/00	99/99/99
203065	IC-74180 GEN CHK PAR 9BIT D/E	3	B	127	1.000	1.000	EA B	N N	1.000	0	0 U6A	00/00/00	99/99/99
203102-001	IC-74221 MLTV MNST DUAL	3	D	128	18.000	1.000	EA B	N N	18.000	0	0 U24B,,24D, 25D,25F,25 B,25K,24F, 24H,25H,25 M,24P,25P, 24S,25S,24 U,25U,24K, 24M	00/00/00	99/99/99

ORIGINAL

LI,200,2.MDATAB01 CIPHER - SAN DIEGO - PRODUCTION DATA BASE
FRI, AUG 19, 1988

BILL OF MATERIAL

AS OF 12/30/93

PAGE NO: 10

CLASS CODE GROUP: 1 UNCLASSIFIED
CLASS CODE: 3400 G.C.R. UNIQUE BOARD ASSY

963674-001 OPCODE: 4 REV: L PWB ASSY-DATA
MODEL:
ECO NO: 30797
DATE OF LAST ECO: 8/19/88

OP: ORDER POLICY CODE
REQ:N=PART OPTIONAL
Y=PART REQUIRED
PF: N=PART DOES NOT PRINT ON SALES ORDER
Y=PART PRINTS ON SALES ORDER W/O PRICE
P=PART PRINTS ON SALES ORDER WITH PRICE

PART NUMBER	DESCRIPTION	O P	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	R E P Q F	DEFAULT QUANTITY	DAYS OFF SET	SEQU	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
203102-245	IC-74LS245 TRANSCEIVER BUS OCT	3	E	129	1.000	1.000	EA	B	N	N	1.000	0	0 U15A	00/00/00	99/99/99
970824-001	IC-74LS688	3	A	130	2.000	1.000	EA	B	Y	N	2.000	0	0 U1M,U3M	5/19/86	99/99/99
962952-001	S/W-GCR,ASSY,ACRC GENERATOR	3	A	131	1.000	1.000	EA	B	Y	N	1.000	0	0 U1J ECO#30797	8/18/88	99/99/99
962962-001	S/W-GCR, ASSY, ECC GENERATOR	3	A	132	1.000	1.000	EA	B	Y	N	1.000	0	0 U6J	7/18/86	99/99/99
203046-150	IC-74LS42 DCDR BCD-DEC	3	C	133	2.000	1.000	EA	B	Y	N	2.000	0	0 U11P,2T	5/12/86	99/99/99
962967-001	S/W-GCR, ASSY,POLYNOMIAL STATE	3	A	134	1.000	1.000	EA	M	Y	N	1.000	0	0 U2P ECO#30797	8/18/88	99/99/99
203102-373	IC-74LS373 LATCH D OCT	3	G	135	2.000	1.000	EA	B	Y	N	2.000	0	0 U2R,5R	5/12/86	99/99/99
203046-148	IC-74LS138 DCDR 3-8 LINE	3	K	136	1.000	1.000	EA	B	Y	N	1.000	0	0 U5T	5/12/86	99/99/99
971165-001	ADHESIVE-MODIFIED CYANOACRYLA*	1	B	143	.001	1.000	EA	F	Y	N	.001	0	0 ECO#30287	1/22/88	99/99/99
208430-900	WIRE-30AWG,KYNAR ROLL,UL	3	E	144	.001	1.000	FT	F	Y	N	.001	0	0 ECO#30287	1/22/88	99/99/99
961707-001	STIFFENER-EDGE,PCB	1	B	146	1.000	1.000	EA	B	N	N	1.000	0	0	00/00/00	99/99/99
970518-001	BUS BAR-12 PIN,INSULATED	3	A	147	2.000	1.000	EA	B	N	N	2.000	0	0	00/00/00	99/99/99
213271-603	SCREW-PHP,ZINC,6-32X3/16	3	G	148	1.000	1.000	EA	F	Y	N	1.000	0	0	5/12/86	99/99/99
970460-001	NUT-SYNC,6-32,HEATSINK,.220MAX	3	D	149	1.000	1.000	EA	B	Y	N	1.000	0	0	00/00/00	99/99/99
209990-071	ADHESIVE-SUPERBONDER	3	C	151	0.000	1.000	EA	F	Y	N	0.000	0	0	11/22/85	99/99/99
964107-001	HEATSINK	3	A	152	1.000	1.000	EA	B	Y	N	1.000	0	0 XVR1	11/04/86	99/99/99
962957-001	S/W-GCR, ASSY, CRC GENERATOR	3	A	153	1.000	1.000	EA	B	Y	N	1.000	0	0 U3J	7/18/86	99/99/99
962972-001	S/W-GCR, ASSY,POLYNOMIAL STATE	3	A	154	1.000	1.000	EA	M	Y	N	1.000	0	0 U5P	7/18/86	99/99/99
209100-548	TUBING-TEFLON #17	3	B	156	.001	1.000	EA	F	Y	N	.001	0	0 ECO#30592	5/27/88	99/99/99
209998-060	LOCTITE TAK PAK	3	B	157	.001	1.000	EA	F	Y	N	.001	0	0 ECO#30134	3/01/88	99/99/99
971041-001	LABEL-BAR CODE,1.425LX.25W,9.*	3	B	158	1.000	1.000	EA	F	Y	N	1.000	0	0 ECO#30659	5/27/88	99/99/99